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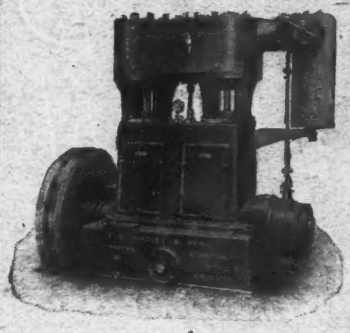

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THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE AGRICULTURAL ELECTRIC SUPPLY AND ELECTRIC POWER COMMITTEES.

A MOST welcome announcement is that which we received early in the week, intimating the formation of a "Committee on the development of electricity in agricultural areas" by the Council of the Incorporated Municipal Electrical Association, and we take this opportunity of congratulating the President of that body, Mr. F. M. Long, on having brought this important matter forward, and equally the Council, on the celerity with which it has given practical effect to his wishes. As our readers are, no doubt, aware, the ELECTRICAL REVIEW, "ploughing a lonely furrow," has in recent years devoted a large amount of space to this subject, and has frequently urged that the time had arrived when the use of electricity in agriculture could, and should, be treated seriously, and regarded as a factor of essential importance in the economic development and progress of our rural communities. Possibly all such suggestions would have fallen on deaf ears had not the war supervened and changed the public outlook from things parochial to things national, and particularly to those matters which are material to the winning of the war, than which—as we can now fully realise—none is more urgent than the increased prosperity and productiveness of our agricultural and allied rural industries. It is, therefore, singularly appropriate that this year's President of the I.M.E.A., whose domiciliary city, Norwich, is the centre of one of our premier agricultural counties, should have given practical shape to the various ideas and suggestions on this subject which have been made from time to time in our columns.

The present Committee is, of course, only a nucleus, with powers to add to itself representatives of the various interests which are essential to the proper organisation of this branch of the industry, which, it will be gathered by reference to the objects in view, covers a fairly extensive range to commence with. In passing, we would suggest that an early opportunity should be taken to include representatives of the company undertakings, whose interest in rural supply developments is undoubtedly as great as, and possibly greater than, that of the municipal fraternity, for although the future will probably show the necessity of forming provincial sub-committees—purely on the ground of convenience in dealing with an extremely widespread industry—yet it is essential that all the interests involved shall be amalgamated and unity of effort secured throughout the country. To us it appears that the primary objects of such an organisation are (1) the creation of a favourable body of opinion amongst the farming community in the proposed areas of supply, and (2) the provision of the necessary transmission systems to meet the demand for electricity as it arises. As regards the former, no great difficulty should be encountered, as the initial areas to be supplied will be those in the vicinity of, and intimately in touch with, towns, for the most part, and as experience teaches that propaganda of this kind is cumulative in effect, progress further afield will be facilitated in the future. The provision of transmission facilities is likely to be a much more knotty problem, however, particularly where the areas of adjoining authorities are involved, and although the Board of Trade can grant the neces-

sary facilities, and all the omens portend that the Board will in the future place a wide and favourable interpretation on its powers relating to electricity supply, much still remains to be accomplished to ensure that such transmission schemes, when required by rural communities, shall be provided expeditiously.

In addition to legislative facilities it may, for instance, be necessary, in the case of small undertakings, to invoke financial assistance in the form of guarantees in the early years, and this is a matter which should appeal directly to the Development Commissioners of the Board of Agriculture, whose *raison d'être* is presumably the support of necessary and useful developments in connection with agriculture, such as, for instance, the 50-acre electro-culture experiment which will be carried out at Hereford this year.

The whole subject of electricity supply in its relation to industrial progress is, of course, attracting much more attention in official circles now than at any previous period, and it is somewhat significant that the President of the Board of Trade is appointing a Departmental Committee to consider and report on the steps which should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, and particularly industries which depend upon a cheap supply of power for their proper development.

The scope of the Committee's inquiry is such that it must necessarily include the rural consumer, present and prospective, in its survey, and thus, indirectly, the needs of the farming industry. Rural England is, perhaps, more awake to the advantages of electricity supply than is usually supposed, as witness the recent resolution of the Ewell Parish Council which was submitted to the Board of Trade, pointing out that the Council was of opinion that one of the greatest needs of rural parishes in the South of England was cheap and reliable power, and that this would do more than anything to keep the village industries alive, and expressing a desire for a cheap supply of electricity in the parish at the earliest possible moment.

We can only add the hope that the efforts of the above Committees and of those already at work, to which attention has been drawn in our columns, will result in that widespread development of electricity supply which is undoubtedly vital to our national prosperity.

Effect of the War on Construction Contracts.

The case of the Metropolitan Water Board *v.* Dick, Kerr & Co., Ltd., decided by the Court of Appeal on March 5th, involves the consideration of a point of great interest to those whose contracts are affected or suspended by the war. The Board had employed the defendants to construct certain reservoirs for £673,000. In February, 1916, while the work was being executed, the Ministry of Munitions decreed that it should cease. Subsequently the Board claimed, in an action at law, a declaration to the effect that the contract was still subsisting, and that the defendants were bound to perform it. Mr. Justice Bray, in a judgment upon which we commented at the time, decided that this was so. The contractors appealed from his decision, which was based on this: that the engineer under the contract had power to extend the time of completion, and that, notwithstanding the order of the Ministry, the contract had not been frustrated or its completion rendered physically impossible. The Court of Appeal have reversed this decision, pointing out that, upon the authority of the decided cases, every bargain must be presumed to have been made on the footing that a particular thing, or state of things, would continue to exist. The Master of the Rolls found that the contract could not be performed after the receipt of the notice from the Ministry. "This," he said, "was not a temporary prohibition. . . ." The contractors treated it as of such a nature as to terminate their liabilities under the contract, and the fact that the restraint, which had been in force for six months at the date of the trial, has now been in existence for 12 months, is a matter to which the Court is entitled to have regard. On this ground alone he thought the appeal should succeed. Having regard to the large number of contracts which must be in a state of suspended animation owing to the war, this decision is likely to be far-reaching in its effect. Serious, indeed, would be the liabilities of contractors if they had to recommence work upon pre-war terms at such time as the Ministry of Munitions might be able to allow the resumption of work. The case may possibly go to a higher Court.

Problems of the Moment.

Men and women who are living conscientiously in these days have few idle hours. We do not pretend that this is a good thing for us, change and recreation of some kind or other being essential if we are to give our maximum efficient output during our working hours. Creatures of circumstance, however, we work under the pressure imposed by necessity; patriots, in earnest concerning a righteous conflict, we labour under the impulse of Duty. Most of us are trying to reconcile these two calls of the moment. Depleted staffs impose heavier burdens, and National Service demands add an almost irresistible appeal. The manifold Governmental restrictions of war-time—the "Thou shalt's" and "Thou shalt nots"—are themselves, if they are intelligently followed and consistently complied with, a bundle of obligations accentuating the burdens imposed by necessity, and obstructing the path of him who tries to supplement his normal activities with other service. But we have got to win the war, and though we may often be irritated because we think that some things might have been done differently, we yield to the imperative pressure of the moment and get things done. We are not suggesting that everybody is employed to the best of his ability, or upon the tasks for which he is by experience and training most fitted, but some men who are so engaged find themselves in a quandary 'twixt the calls of present duty and the appeal to change to other forms of service. So long as the call for National Service is on a voluntary basis the individual conscience must play a very important part. The electrical industries are in the main an important National Service; but there are demands from the Military and Naval Services for men from those industries, because the actual and prospective operations of the Forces necessarily have a large claim upon us all. The difficulties of reconciling the two claims are not always easily solved by those in authority, and men have to leave more or less congenial occupations, for which they thought they were best fitted to serve the national cause, and take up some other class of work, perhaps a lower class of duty in the same line of occupation and at a less remuneration, because those responsible for carrying out the provisions of the Acts decide that the emergencies of the moment or the possibilities of the situation demand the change.

For this we must blame the enemy first and foremost, and work harder to defeat him; but, second, we will ask to be allowed to remember that we live in a very human and inefficiently conducted world. The thoughts of some of our readers we believe to run along the foregoing lines just now, especially those who are placed in managerial capacities in industrial concerns and in important commercial offices; these will hardly be relieved in days of exceptional pressure when they read Press reports of speeches such as Mr. Gordon Selfridge delivered at

Gresham College the other day. Copy-book maxims on how to succeed in business are all very well in peace time, or for instilling into juvenile minds even in war time, but to tell us all in these days that "the head of the business should not be busy, because he would then have no time to see that others were busy," is to utter a platitude which everybody should have known in normal times, and will practise again when the stress of war-time passes away; but where are the heads of businesses who in these days of depleted staffs, manifold restrictions, and urgings toward business development for the future, are not busy? Of course, it makes for efficient conduct of any business of size for the heads to be able to *think* and plan while the employés develop and carry out the details of policy in their own efficiency; but in our experience most managers are thinking, planning, and *working* hard as well at present. In normal times the efficient manager knows it is correct policy not to be too much tied up with detail, but surely in these days most of us are doing many unaccustomed tasks because necessity and duty compel; maxims such as this from what Mr. Gordon Selfridge calls his "Commercial Bible" hardly help us just now—we will get on with the work which must be done, whatever it may be, and leave others to do the talking.

The Wire-Drawing Industries.

In common with almost every other controlled industry, the wire manufacturing section has had to face an increasing variety of difficulties; but, although the dislocation caused by the exigencies of the situation has in some cases proved of a somewhat serious nature, resourcefulness and perseverance have materially eased the situation. The complete control exercised by the Ministry of Munitions on all supplies of raw copper, while dispensing with a considerable amount of duplication, has doubtless reacted somewhat unfortunately, as regards fluctuations in market prices, against those firms which had bought some months ahead. So far, only Class A men in the unskilled section appear to have been called up from the most important firms, but there is likely to be a heavy pruning-out very shortly of semi-skilled men, and possibly certain classes of skilled men also. It is, perhaps, fortunate for British wire manufacturers that nearly all their most important pre-war customers are themselves engaged in the production of war material for which copper goods are largely required. The transition after the war from munition requirements to the demands of peaceful trading should, in consequence, involve the minimum expenditure of time and money.

Water Power in Italy.

A new law in regard to the partial diversion of public waterways in Italy was brought into operation on January 1st, 1917. The coal crisis in the country has demonstrated the necessity for at once utilising to a greater extent the available water powers with more certain guarantees than those comprised as a matter of urgency in the decrees issued in January and September of last year. Under the new law the duty of dealing with the problem has been entrusted to a Superior Water Council, formed in connection with the Ministry for Public Works.

The procedure for obtaining a water-power concession has been simplified. The criterion of priority, which permitted injurious monopolies, has been modified, and replaced by those of greater and better utilisation. Concessions are to be granted for a period not exceeding 50 years for diversions for motive power purposes, and for not over 70 years for those for irrigation and potable purposes. If the objects for which the concessions are issued continue, the latter will be prolonged at the normal time of expiration. The concessions which lapse will pass into the possession of the State without any compensation being payable for the water collecting and regulating works, the canals and the conduits, whilst the State will have the right of acquiring, at the then value, the machinery and installations for producing, transforming, and distributing electrical energy.

The introduction of the law has not fully met the wishes of the Associazione Elettrotecnica Italiana. Shortly before the measure came into force a conference was held, at the instance of the Association, to consider the situation created by the scheme, and a resolution was adopted expressing regret that the problem of amending the law had not been postponed until after the war, so that the questions raised could have been properly discussed and definite measures adopted with the assistance of Parliament and the country. At the same time, and recognising the urgency of providing for the increasing demand for electrical energy during the course of hostilities, the resolution submitted that the construction of hydro-electric works would be facilitated by an extension of the decree of last September so as to apply to all requests for concessions for new diversions of waterways, irrespective of the applicant. The conference finally decided to form a permanent committee on public waterways, composed of representatives of all technical, industrial, and agricultural associations.

Irish Water Power.

In a recent speech, which excited a great deal of interest in the *Times* and *Daily Mail*, Lord Northcliffe declared that the Irish problem, in his opinion, was an economic one, and suggested that the solution would be found in the development of the water power available in Ireland. He had "sought eagerly for any recent expert report on the water power of Ireland," but without success; unfortunately, he did not seek our assistance—had he done so, he would have speedily arrived at the desired end, for the subject has been dealt with on various occasions. Lord Northcliffe's enthusiastic accounts of the "white coal" resources of Ireland are unfortunately, in the absence of expert guidance, based upon supposition to a great extent, and we fear that the reality will prove disappointing to him. It is true that at certain seasons there is a great deal of energy running to waste, but the minimum flow of the Irish rivers is only about one-sixth of the ordinary maximum, and for industrial purposes, unless the hydraulic plant is supplemented (at great additional cost) with steam or gas-driven plant, is is the minimum flow that fixes the capacity of the undertaking. There are certain sites at which power could be obtained close to the sea, and therefore under highly favourable conditions; and on the Shannon, which Lord Northcliffe describes as the greatest river of the British Isles, water carriage to the sea is available. At other places transmission lines would be necessary to carry the power to suitable sites for factories. A valuable feature is the fact that in many cases the rivers are fed from large lakes which could be utilised for the storage of water, greatly improving the possibilities. On the other hand, there are vested interests to be dealt with, such as navigation and fishing rights, compensation for the disturbance of which would involve heavy outlay; moreover, in many cases the hydraulic works would be very costly. That there is a good deal of water power available in Ireland appears to be the fact; but whether it could be developed profitably is, except in a few instances, very doubtful, and we fear that those who build their hopes on Lord Northcliffe's optimistic guessing are doomed to suffer a painful disillusionment.

ELECTRIC COOKING AT A Y.M.C.A. CANTEEN.

Through the courtesy of the British Electric Transformer Co., of Hayes, we are able to illustrate the very complete electric cooking installation which has recently been supplied by them for a new Y.M.C.A. canteen in North London. This canteen is a spacious structure, standing apart from the works, and containing a general dining room and smaller rooms reserved for the works staff and administrative purposes; the architect was Mr. A. Alban H. Scott, of Lincoln's Inn, W.C.

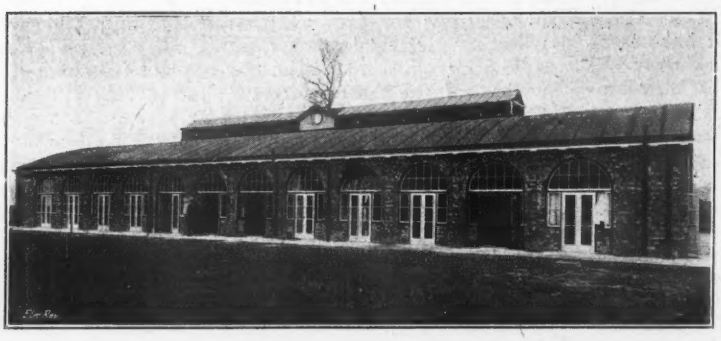


Fig. 1.—Y.M.C.A. "Electrical" Canteen in North London.

Fig. 2.—Interior of Dining Hall, with Electrical Cooking Apparatus in the Foreground.

Some idea of the interior can be gathered from fig. 2, which shows the large hall from behind the cooking apparatus, which it will be noted is in the hall itself—there, of course, being no objection to such a situation in the case of electrical cooking apparatus, owing to the absence of smoke and fumes, and absolute cleanliness of electrical cooking operations.

The principal cooking apparatus is concentrated on a large table, which carries two double and two single "Tricity" ovens, and a number of "Tricity" boiling plates, for cooking vegetables, &c. In addition, a carving table and four hot cupboards adjacent to the counters are installed.

The ovens are of the well-known Tricity pattern, with bright, polished exteriors, each single oven having a top and a bottom heater plate of the ribbed type, while the double ovens have two top and two bottom heaters.

The heaters are each controlled by adjacent "high-low" type switches giving 900 or 250-watt loadings, and are coupled to standard control panels arranged round the edge of the table, each panel containing a fuse, D.P. switch, lamp indicator, and plug connection.

The ovens are provided on the top with hoods for simmering puddings, sufficient heat being available for this purpose from the top oven heater.

In all, 14 plain boiling plates have been supplied, the majority being fitted on the table; each plate has two working loadings giving 225 and 850 watts, with near-by control by means of "high-low" switches, and coupled to a standard control panel, as in the case of the ovens. For use in connection with these plates, there have been supplied four large boilers (26 in. × 15 in. × 12 in.),

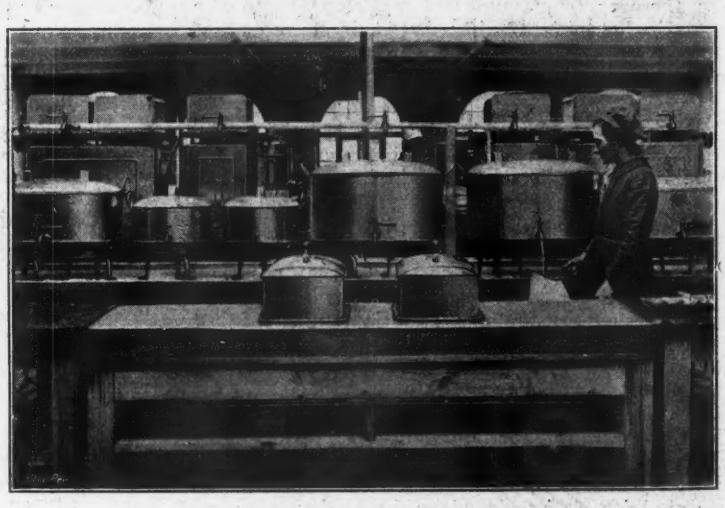


Fig. 3.—Electrical Boilers and Carving Table.

fitted with wire baskets and draw-off taps, for cooking potatoes, vegetables, puddings, &c.; three similar boilers,

each of 10 gallons capacity, for boiling water for making tea; three ham boilers; also six saucepans of 6 to 12 pints capacity. Two cover plates are provided for standing over the boiling plates, so that several utensils can be heated at the same time.

Fig. 4.—"Tricity" Hot-cupboards at a Y.M.C.A. Canteen.

The carving table, 6 ft. 6 in. × 2 ft. wide and 5 ft. high, is fitted with two tinned copper meat dishes and nickel-plated covers, and with 1½ kw. of heaters of the maker's new "Flamingo" (red hot) pattern. The four hot cupboards, each 7 ft. long, 3 ft. 3 in. high, and 1 ft. wide, which form part of the counter enclosing the cooking space, are built up of sheet steel, with angle-iron frames. Three of these are fitted with eight shelves to take plates of meat and vegetables—(64 in each), in order to facilitate serving, while one has five shelves for warming-up food supplied by the men themselves.

Each hot-cupboard is heated by elements of the "Flamingo" type, with a total loading of 3 kw., controlled by three switches. This apparatus is all operated on 120 volts, the ovens and boilers being balanced on either side of a 240-volt three-wire system of supply, which is introduced through a cast-iron distribution box installed under the cooking table, the outgoing circuits being carried in conduit, with flexible armoured connecting cables to the apparatus. Special heat insulated urns are provided on the counters for keeping the tea warm for serving.

The water for kitchen requirements is obtained from a small Beeston Domestic coke-fired boiler, and an Ideal boiler, working in conjunction with a small electrically-driven centrifugal circulating pump, supplies the hot water required for heating the building.

The canteen is under the charge of a lady superintendent, who is assisted by a staff of voluntary and paid workers, and at the present time about 150 hot meals are supplied at midday and a similar number of light meals in the evenings. Very few firms indeed can boast of such an excellently situated and well-equipped establishment in connection with their works, and both the promoters and users are, in this case, to be congratulated on a happy result.

DECIMAL COINAGE AND THE METRIC SYSTEM.

Our readers will remember that in the autumn of 1915 we devoted a considerable amount of space to the advocacy of drastic reforms in our currency and weights and measures—reforms which, in our opinion, are long overdue, and for which the present circumstances afford the most favourable opportunity imaginable. We showed that, as a result of a series of questions which we addressed to a large number of manufacturing firms in the electrical and allied industries, the replies were in a majority of four to one in favour of the adoption of decimal coinage and of metric weights and measures in this country, and we endeavoured to demonstrate by detailed argument and illustration that the change was desirable in the interests of our manufacturing industries and trade, both internal and external; that it presented no serious difficulties; that the cost and disturbance to manufacturing operations would be vastly less than was alleged by the opponents of the scheme, and

Fig. 5.—"Tricity" Ovens and Boilers at a Y.M.C.A. Canteen.

that in view of the general reorganisation of our industries and the fierce trade war that would follow the cessation of hostilities, it was imperatively necessary to proceed with the matter without loss of time. That the opportunity to do so is ideal and unique is obvious, for the people of this country have been roused from lethargy by the German attempt to break up and destroy the British Empire, and are ready to receive and consider new ideas ; the prices of commodities have been inflated to 50 or 100 per cent. above their normal value, so that the slight change required to decimalise our coinage would be a mere flea-bite ; and the reorganisation on an enormous scale of factories and workshops that have been employed for the manufacture of munitions would greatly facilitate the introduction of metric measures on the return of peace, when, moreover, prices will be falling, so that the adoption of metric weights for ordinary commercial transactions would take place in a time of flux. Further, some millions of our fighting men will be returning from the front, where they have acquired a familiarity with decimal coinage and the metric system which, beyond all doubt, will have dispelled their latent aversion towards foreign methods, and will exert a tremendous influence upon public opinion at home.

Arising out of our articles on this subject, correspondence followed, both in our pages and privately, the latter continuing at intervals for over twelve months, and it has become clearly manifest that public interest in the matter is steadily growing. One of the most important developments of the past year in this relation was the formation of the Manchester and District Decimal Association, under the patronage of the Lord Mayor of Manchester and many other distinguished leaders in industry and commerce, with Mr. Harry Allcock as hon. secretary. A particularly significant feature of this movement is the fact that amongst the vice-presidents and on the Council are many of the most prominent men at the head of the textile industry in this country, including the chairman of Council, the hon. treasurer, and the hon. secretary of the Textile Institute (it has always been maintained by opponents of the metric system that our textile manufacturers could not, and would not, adopt metric measures). The Chambers of Commerce of this country have for many years repeatedly passed resolutions calling for the adoption of the decimal system, and quite recently many of our Borough Councils and Corporations have likewise expressed their views in favour of the reform, and it will be remembered that the Council of the Institution of Electrical Engineers included it in its programme recommended to the Board of Trade Committee on the Electrical Industries after the War, while the B.E.A.M.A. similarly commended it to the attention of the Committee. The Associated Chambers of Commerce of the United Kingdom have gone further still, having drafted two Bills relating respectively to decimal coinage and to the adoption of metric weights and measures, which they have circulated to Chambers of Commerce for criticism or approval ; and, lastly, we may remind our readers that the Institution of Civil Engineers has arranged to hold a discussion on the subject next Tuesday evening (March 27th), to which members of the Institution of Electrical Engineers and other kindred associations are invited.

In these circumstances, it will be admitted that the subject is very much alive at this time, and it may be useful to discuss briefly some of the points which crop up when this very important matter is under consideration.

In the first place, the proposal to adopt decimal coinage claims attention. This, it is urged by the Decimal Association—which for many years has carried on the campaign with admirable persistency, though hampered by want of funds—should be carried through before the conversion of our weights and measures to a rational system, so that the public may become familiarised with the modified coinage first ; we say "modified" advisedly, for our present coinage can be decimalised with the greatest ease, and without altering the value of the sovereign or of any of our silver coins, whilst the change in the bronze coins would not exceed 4 per cent. (this need occasion no loss to the public, as the Government would call in all existing bronze coins and pay for them at the true equivalent rate). We have contended that the sovereign shall be permanently retained as a fundamental standard, thus maintaining continuity with past records, and we are pleased to note that the Coinage Bill of the Association of Chambers of Commerce endorses this view ("Clause 4. The sovereign shall remain as hitherto the 'essential unit' of value. The florin, the tenth part of the said sovereign, and the hundredth part of the said florin (hereafter called the 'British cent') shall become Coins of Account . . ."), though we do not necessarily agree with the nomenclature contemplated in the Bill.

We do not propose to dwell at length on the subject of decimal coinage, as its merits are so generally conceded ; the whole world, with the exception of the British Empire (and not by any means the whole of that), Siam, and Persia, has already adopted decimal coinage, and the opposition to the change in this country is weak and of little weight. The saving in time and labour that would result from the reform would be enormous, and would be particularly appreciated in commercial circles ; it would, for instance, be possible to adopt adding machines of the same pattern as are used in other countries, instead of the more complicated type required to deal with our factors 20 and 12, and the casting up of columns of figures without mechanical aid, the calculation of interest, &c., would be immensely facilitated. The very fact that we reckon so largely in percentages itself affords proof that the handiness of the decimal system is already fully appreciated in this country, and we feel sure that there would be no greater difficulty in adopting it than has been experienced elsewhere. We hope, therefore, that this most salutary measure will be pressed forward and carried into effect with as little delay as possible.

Turning to the metric system of weights and measures, we find that the opposition to their compulsory adoption is far more serious and weighty than in the case of coinage. The objection which is perhaps most frequently advanced is that the change from our existing units will be very costly to engineering manufacturers, involving the scrapping of tools, jigs, templets, patterns, drawings, and measuring instruments, and the adoption of new standard designs for machines, &c. While there is a proportion of truth in this view, it is so small a proportion that it would be more correct to describe the statement as almost entirely erroneous. No alteration would be required in workshop plant, and no alteration would be compulsory, for the draft Metric Bill expressly states that compulsion would apply solely to sales and purchases, and not at all to manufacturing processes. Take the case of a dynamo maker who preferred to continue manufacturing to British measures ; he would not be affected by the Bill except in the compilation of his catalogues and price lists, and as a very large number of manufacturers already embody metric equivalents in their lists, the only effect of the change would be the omission of the British measures—actually a saving in the cost of printing and binding ! Needless to say, we do not suggest that he would be pursuing a wise policy in thus depriving himself of the benefits of the metric system in his workshops ; we only wish to show that the passing of the Bill into an Act would not necessarily put him to any expense—though we should think that he would soon find it to his advantage to adopt metric units, on account of the handicap which he otherwise would impose upon himself by his adherence to obsolete practice.

So far as existing drawings and designs are concerned, it cannot be too strongly emphasised that no changes in dimensions will be necessary—*it is only the names of the dimensions that must be altered* in order to put the metric system into force. We have shown conclusively that measurements usually stated in thousandths of an inch can be expressed in hundredths of a millimetre to a closer degree of approximation than can be worked to in the shops. A mil is very nearly equal to $2\frac{1}{2}$ hundredths of a millimetre, and hence if dimensions stated in mils are expressed in terms of the nearest hundredth of a millimetre the maximum error cannot be half a hundredth of a millimetre, and the average error will be $\frac{1}{4}$ of 0·01 mm., or 0·1 mil. Now, it has been proved by extended investigations conducted by the National Physical Laboratory that in practice the accuracy of measurement attained in the workshop is seldom as close as half a mil, and the accuracy of the dimensions of the finished work is still lower, the error averaging more than $1\frac{1}{2}$ mils.

or 7½ times the maximum error that need occur in figuring the drawings in hundredths of a millimetre. (We use both vulgar and decimal fractions of set purpose.) But the great majority of dimensions of machinery do not require anything like so high a degree of accuracy—frequently the nearest millimetre would serve perfectly well, and the cases in which the equivalence must be carried beyond $\frac{1}{10}$ mm. are comparatively few. In proof of this statement we cite the actual example of a dynamo spindle, which we discussed very fully in our issue of November 12th, 1915; out of the 28 dimensions, expressed in tenths of a millimetre, 18 were correct to less than one mil, 24 to less than two mils, and not a single dimension need have been figured beyond the nearest tenth of a millimetre. For very fine work (which, in English units, invariably necessitates measurement to the fourth place of decimals), the hundredth of a mm. serves all ordinary purposes, giving a maximum departure from true equivalence of $\frac{1}{5}$ of a mil (0·0002 in.). Under modern conditions, the use of limit gauges being almost universal, a tolerance, rarely less than one mil, and often much greater, is always specified, so that in such cases to go beyond the hundredth of a millimetre would be mere pedantry. Working to gauges, jigs, and templets, the operator has nothing to do with the figured dimensions at all, and therefore no trouble can arise from the use of the metric system on drawings; those who have to take measurements direct from drawings are, *ipso facto*, shown to possess a reasonable degree of intelligence, and, therefore, readily become accustomed to the use of the new units. That this is so is abundantly proved, if, indeed, at this date proof is needed, by the fact that in innumerable engineering workshops on both sides of the Atlantic, jobs are in progress to both English and metric measures, and no trouble has resulted. It may be interesting to quote here some statements published in the "Correspondence" columns of the *American Machinist*, emanating from readers who disagree with the strongly hostile attitude of that journal towards the metric system:—

"I have worked in shops using the two systems for the past 20 years, and I have yet to hear the first complaint from a practical shop point of view against the metric system. At the works where I am at present, the tool makers and machinists, when they have a job to do where the dimensions are given in inches (such as locating holes in jigs, &c.), invariably transpose them to millimetres, as there is less chance of error in reading measuring instruments in millimetres than in inches, notwithstanding the fact that an equal number of measuring tools are provided for each system. I have had a number of apprentices under my charge from time to time, and I have found that in every case they grasp the method of reading the instruments in the metric system in about as many minutes as they do the other system in the same number of weeks." "Shop calculations are much simpler with the metric system." "I have also observed that it is much easier for draughtsmen to visualise sizes in millimetres than in fractions of an inch.—J. Pearman, of Walthamstow.

"A good many of our manufacturers are already using the metric system in filling foreign orders, and I believe that it has become so much the international standard that no foreign buyer asks for any other." "It did not take me long to become perfectly familiar with such of the dimensions as we used. It was certainly not over a month or so before I could think in centimetres as readily as in inches—without any translating of one into the other."—W. B. Greenleaf, of Plymouth, Mich.

"While we are talking about the 'cost' and the 'confusion' likely to accompany the adoption of the metric system in this country, the system is being adopted here and there practically without the slightest confusion, and at a cost so nominal, that it is not to be considered. Orders from other lands for materials made to metric dimensions are being taken and filled almost daily by many of our leading industries. It appears to take us no longer to handle an order from France than one from England, the one in metres and the one in inches, the one to be paid for in francs and the other in pounds, shillings and pence. While some learned professor is telling us how 'impossible' it would be for us to work in metrics without the utmost disturbance and at great expense, we are busily engaged in doing exactly that thing, without any appreciable disturbance, and at an expense readily absorbed by the selling price."—*Valve World*, quoted by H. V. Haight, of Sherbrooke, Quebec.

"The metric system was established in Sweden about 1888, to the exclusion of all other systems of measurement. . . . At the time when this law was passed I was connected with the Gothenburg Mechanical Works, employing between 1,000 and 1,200 men. The lines of manufacture were steam engines, steam boats, rolling stock for railroads, bridges and other structural work, paper-making machinery, agricultural implements, &c. The change from inches to millimetres was immediately started. All new drawings were made in the metric system, and when an old drawing was to be used the dimensions in inches were enclosed by parentheses, and the dimensions in millimetres added. At that time Swedish, English, and Prussian inches were used in shop work. It was a relief to throw them out and use millimetres. In this shop the metric system reduced the number of errors in the drafting room and the cost of manufacture.

"The change was carried through with practically no expense whatsoever. The taps in the Whitworth system were kept, as they had to be used for repair work. Later on metric taps were gradually substituted. The only direct outlay was for scales, as a greater number had to be procured at once than were required for replacing worn ones. This extra expense did not amount to $200.

"It is surprising to see how the use of the metric system is spreading in this country [U.S.], and the time seems to be drawing near when this adoption will be general."—Carl F. Jeansen, Ordnance Engineer, Washington Navy Yard, D.C.

The following quotations from other sources may also be of interest:—

"It is surprising with what facility the average soldier becomes accustomed to French money. Everything out here is bought and paid for on the decimal system. The men and officers receive their pay in French money. I have seen bills made out and paid by officers' orderlies which show that they are quite at home in the French system. . . . Everybody out here has become familiar with decimal money, weights, and lengths, and knows roughly the ratios between them and corresponding British measures. The present opportunity is one which ought not to be missed."—C. F., France, in *Nature*.

"We who live and do business on the Continent of Europe are, perhaps, better able to judge than the great mass of people in England of the enormous advantage this change would bring to England and English post-war trade and commerce with foreign countries. It would also doubtless be greatly appreciated in England itself after it had been given a short trial, entailing as it would the abolition of our present complicated and well-nigh incomprehensible system of weights and measures. The present moment would appear to be a very favourable one for the change."—J. T. Trewhella, in the *Bulletin* of the British Chamber of Commerce for Italy.

"Two years ago American factories worked under (as we do to-day) the 'foot and inch' measurements; then orders for millions of shells and other war materials came from countries who used the metric system, and their orders were as described in their specifications.

"The engineers in America now find it easier to work on the 'metric' measurements than to reduce them to the 'foot and inch,' consequently the workers as well as the employers have a very extensive and practical knowledge of its use, and it has been a revelation to them to find how much simpler it is compared with the 'foot and inch' and its unwieldy fractions. There is now very little doubt that by the end of the war it will have become their standard measure in America.

"This is an important point for consideration, as to whether England should not at once decide on adopting it, for if the Americans use it as their standard, it will greatly influence the markets of South America, where only the metric system is in use; it would also handicap us in competing with America in countries where we now find considerable difficulty in doing trade, on account of our different measurements."—T. B. Callard, of Chesham Bois, Bucks, in the *Times*.

"The question of introducing the metric system into the United Kingdom after the war is receiving close attention. We sincerely hope that means may be found to do this, as, apart from its inherent convenience and superiority over the existing system, its adoption, more particularly as regards weights and measures, would undoubtedly tend to facilitate and to augment trade with many foreign countries, particularly the South American Republics."—*Review of the River Plate*.

We could go on to quote from the utterances of numerous authorities in commerce, finance, and engineering as to the pressing need for the reform that we are advocating, but considerations of space forbid it, though we possess abundant material. We can only deal with a few of the stock arguments with which the proposal is met. Arguments about the inaccuracy of measurement of the earth-quadrant are irrelevant; the metre, as we know it, is the distance between two points on a certain metal bar, and no one cares a doit about its relation to the earth's circumference.

With regard to the effect on standards, such as those of the British Engineering Standards Committee, a point on which Dr. C. C. Garrard laid stress in a letter to the *Times Engineering Supplement*, it is a mistake to suppose that, as he suggests, they would all have to be scrapped. They need not be altered at all, though, as they came under revision (and standards, if they are to be of any use, *must* be revised from time to time) they could be modified if it were found desirable. Steel rails, for example, could be sold by the metre or metric ton as easily and conveniently as by the yard or ton, and, in course of time, on the reissue of the specifications, the dimensions of the treads, flanges, &c., could be refigured in millimetres. It should be borne in mind that no standards ever are, or ever can be, *exact*; allowance is invariably made for variation from the specified

dimensions, and this, in the case of steel rails, covers a range of 1 per cent. (by weight). Hence it is not necessary to employ equivalents precise to the tenth of a millimetre in such tables. In figuring to the nearest millimetre, the maximum error is only $\frac{1}{80}$th of an inch, and the average error $\frac{1}{160}$th inch. As a first step, the metric equivalents may be added to the English measures, and eventually the latter will fall out. In this connection it is interesting to note that the Newcastle Local Section of the Institution of Electrical Engineers has adopted unanimously a resolution urging the Standards Committee to prepare modified specifications in readiness for the adoption of the metric system, and to state new standards in even metric measurements. Now, Tyneside is one of our principal engineering centres.

Another point of importance in this relation is the fact that many "standards" are merely nominal, and might just as well be denoted by letters or numbers as by figured dimensions, as the latter are not used in practice. Take, for example, the case of steel conduit; the outside diameters are specified with limit gauges having tolerances varying from 2 to 8 mils, but the inside diameters are nominal, and are determined by the weight, which must fall between limits affording a range of 10 to 18 per cent. The thicknesses of dielectric and lead sheathing for copper conductors are mostly stated in mils; but a variation of 10 per cent. below the standard minimum thickness is allowed, and the thickness may exceed the specified value at pleasure. Similar latitude is met with in scores of cases in the standard specifications, indicating plainly that the substitution of metric units would not usually necessitate any modification in the actual sizes. The standards for the heads of small screws (Report No. 57) are all based on mm. and converted to mils, using the nearest mil.

Having examined many of the B.E.S. specifications, we have come to the conclusion that no difficulty need be anticipated in adapting them to the metric system, with practically no breach of continuity or inconvenience to manufacturers or users of the materials dealt with. On the other hand, there is undoubtedly a difficulty in connection with rolled and drawn metal sections, such as rods and bars, shafting, &c., of which during the transitional period it might be necessary to carry stocks in both dimensions; these, as well as drills, would eventually have to be provided to even metric sizes—but in very few other cases would even measures be necessary. The wire and sheet gauges need not be altered, and their metric equivalents are already given in the tables. In this connection we would enter a plea that in giving equivalents in the two systems, the figures be confined to the necessary and sufficient limits. Fine work may be measured and wrought to the ten-thousandth part of an inch, and that is the extreme limit with hardly any exceptions; there is never any need, therefore, to carry the English equivalents beyond the fifth place of decimals, which enables the fourth to be correctly defined, and it is rarely necessary to go beyond four places. Similarly in giving metric equivalents of English measures, it is sufficient to give at most three decimal places. The foregoing applies to small length measurements in terms of inches and millimetres, but when larger sizes are in question, still fewer decimal places will often suffice, and when dealing with areas, volumes, and weights, five significant figures (giving a minimum accuracy of the order of one part in 10,000) meet all practical requirements. We refer, of course, to workshop conditions.

As regards the textile industries, which are usually held up as inveterate opponents of the metric system, we have already mentioned that in Manchester leading textile authorities are actively supporting the movement towards its adoption. Metric measures have actually been employed in the Department of Textile Industries of the Bradford Technical College during a term by way of experiment, under Prof. A. F. Barker, Director of the Department, who reported that "were it a necessity to change from the various English to the metric measures, such a change would be made as easily as the transition from the Leeds to the Bradford, or Bradford to Manchester trade; in fact, greater changes have already been introduced into certain trades with little disturbance. . . . It was truly surprising how quickly one adjusted oneself to the new conditions." In Germany last year, a committee of German cotton-spinning organisations, representing 96 per cent. of the 12,000,000 spindles in the Empire, unanimously decided to recommend to the Imperial Government the introduction of the metric system of numbering yarns, the present time being considered favourable for making the change.

In conclusion, to those who are opposed to the metric system on the ground that they consider the English units superior, we would say: if you asked a "metric" country to adopt our measures, what answer would you expect to receive? Would any such country entertain for one moment such a suggestion? If not, why?

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

New Electrolysers.

The use of electrolysis for the production of sterilising liquid has proved highly successful during the war, on board ship and in hospitals and laundries, and Messrs. Vincent Roberts & Co., of Leeds, who have acquired much experience in this connection, have recently introduced improved types of apparatus designed to facilitate and extend the employment of electrolysed brine and sea-water. Their patent electrolyser, which is illustrated herewith (fig. 1), consists of a rectangular box of porcelain divided by the electrodes into a number of compartments, so arranged that the brine entering at the highest point at one end flows down under and over the electrodes until it passes out at the lower end, charged with hypochlorite of soda. The illustration shows a complete installation, comprising the brine dissolver and agitator on a strong

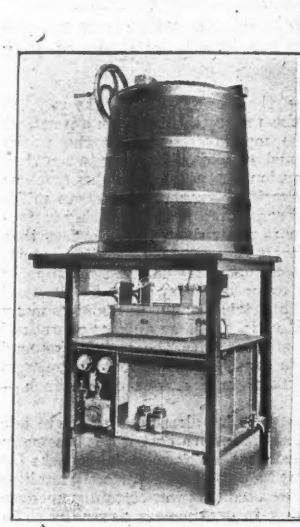


Fig. 1.—Laundry Electrolyser.

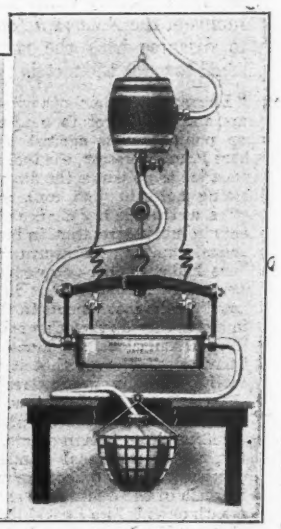


Fig. 2.—"Reuss & Roberts" Electrolyser for Ship Use.

wooden stand, automatic supply tank, slate storage tank with liquor level and stone tap, and the electrolyser with its switchboard and accessories.

The strength of the solution, with a constant current, is regulated by the rate of flow of the liquid, which can be adjusted to suit requirements, and kept there by means of the automatic feed tank, which is provided with a float valve and adjustable feed valve set to deliver 12 gallons of brine per hour. The current required is 8 to 10 amperes at 110 volts, and the product contains 3 gm. of available chlorine per litre (= 0·3 per cent.). Besides its property of sterilising clothing, &c., the liquid has the power of bleaching all vegetable fibres, without destroying the material, and does not curdle soap, but rather saves it by promoting lathering. Tests made by the medical officer of the L.C.C. Asylum at Bexley show that with the electrolysed product diluted to a strength of 0·5 per thousand, any fabric can be bleached and sterilised with safety and economy.

Of course, the type of apparatus referred to could not be used on board a ship, owing to the movement of the latter; but fig. 2 shows a new patent type which meets the conditions, the whole apparatus being suspended from above, and the connections made with flexible tubing, so that the process can be carried on continuously, independently of the ship's motion. The electrolyser itself can be set at the proper inclination by moving the suspension hook

towards one or other end of the beam which is pivoted on it; the porcelain spouts at the ends serve as pivots, as well as inlet and outlet, and thus enable the vessel to be inverted for cleaning. The automatic brine tank also has to be slung, to prevent interference with the action of the float controlling the feed; and the collecting tank is slung below the rest of the apparatus, to prevent the liquid from being churned up in contact with air, which would tend to decompose it.

Wadsworth Lifts and Transporters.

Messrs. Wadsworth & Sons, Ltd., of Bolton, manufacture a great variety of lifts, hoists and transporter gear, of which we illustrate typical examples. Wadsworth lifts are built for either continuous or alternating-current working, and for the following methods of control:—(1) Hand-rope; (2) switch-in-car; (3) semi-automatic ("up," "down" and "stop"), pushes on landings and in car, and (4) full automatic push control from landings and car.

The first and second systems are suitable for slow and fast speed, goods and passenger work respectively; the semi-automatic type is generally used on light goods' lifts, and occasionally for passenger work, while the complete automatic type is for passenger work.

We illustrate a Wadsworth under-type lift machine in fig. 4; with the exception of the motor, it is manufactured throughout by the firm, as also over-type machines for similar work.

Fig. 3.—Electric Lift with Overtype Machine.

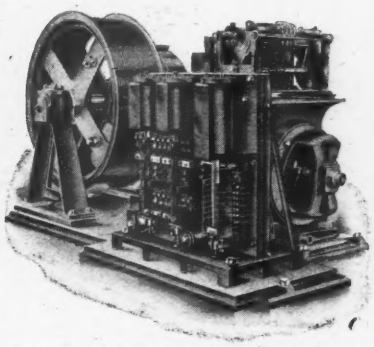


Fig. 4.—Standard Electric Lift Gear.

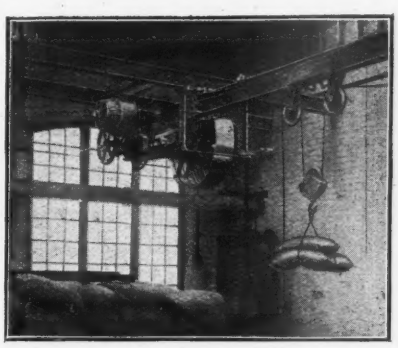


Fig. 5.—Transporter in Messrs. Lever Bros.' Works.

The lifts are fitted with collapsible gates or hinged doors, which are provided with the firm's improved electromechanical lock.

Fig. 3 shows a lift fitted with collapsible gates and with hoisting gear mounted above. Messrs. Wadsworth also supply a patent belt-driven lift in which the belt movement "on" or "off" is electrically operated by a switch in the car, this arrangement placing the belt-driven lift on the same plane as the car-switch controlled electric lift. The absence of hand-ropes and chains is an obvious advantage, and the doors can be fitted with safety mechanism preventing starting unless the doors are closed and bolted.

Fig. 6.—Five Electric Transporters at Port Sunlight.

Figs. 5 and 6 illustrate Wadsworth transporters in use. These are built in sizes ranging from 3 cwt. to 80 cwt., and for any speed, and can be arranged to travel any distance in a straight line.

These transporters are rope or motor-driven, one handle controlling all motions, the handle movement corresponding to the movement required of the transporter. Two types of transporter carriage are supplied; one of rigid construction, suitable for short-distance travel where fast speed is not really essential, and one, arranged with swinging pulleys, to allow of goods being picked up or deposited at each side of the traveller beam. The carriage is provided with safety catches to automatically arrest the carriage at each end of the travel without exerting any strain on the stop blocks.

Messrs. Wadsworth are also makers of warehouse jib cranes, friction hoists for electric or belt drive, and hand lifts.

THE NEW BUFFALO POWER STATION.

Recent issues of the *Electrical World* and *Power* describe the new steam power station of the Buffalo General Electric Co., which has come into being through the curtailment of Niagara power imported into the United States from Canada.

The supply to the Buffalo Co. from Niagara sources is said to fall at least 25,000 h.p. below requirements. The new plant will provide sufficient energy to carry all peaks at present and to meet additional load demands for some time. The new station is built on the bank of the Niagara river about seven miles north of Buffalo, and has an initial equipment of three 20,000-kw. horizontal turbine sets, while a 35,000-kw. set is on order for starting up early next year. The ultimate capacity of the station is given as 210,000 kw. Particular interest attaches to this installation, as it has been designed with a view to competing with the power now purchased by the company from Niagara hydro-electric sources.

Construction was begun in January, 1916, and the first turbine was in commission on November 20th of the same year.

The building is a steel frame structure, with outside walls of brick, consisting of a boiler-house with overhead bunkers, turbine and switch houses; the foundations rest on 167 concrete caissons sunk to bed rock.

Coal is received by railway, and dumped into hoppers, each holding several car loads, which discharge into crushers, which are in duplicate, and each of which feeds a bucket elevator for lifting the coal to a belt conveyor running above the coal bunkers. Two 30-in. wide belt conveyors run over the bunkers; the conveyor and elevator, and crusher feeding the latter, are provided with emergency push-button control at several points.

The completed design provides for an external coal yard with travelling bridge crane and a storage capacity of 50,000 tons, which will be connected by belt conveyors with barge unloading hoists on a coal wharf on the river side. The overhead bunker capacity is 2,500 tons, fuel being spout fed to the stoker hoppers below.

Five double-ended Babcock boilers are installed at present, the firing aisles being arranged across the building, so that both ends are accessible, with a central connecting gangway running the length of the building. The boilers are designed to supply steam at 275 lb. working pressure, with 275 deg. F. superheat; each has 11,400 sq. ft. of heating surface, and is fired by two 15-retort Sanford Riley stokers, one at either end, the ratio of heating surface to grate area being 36 to 1.

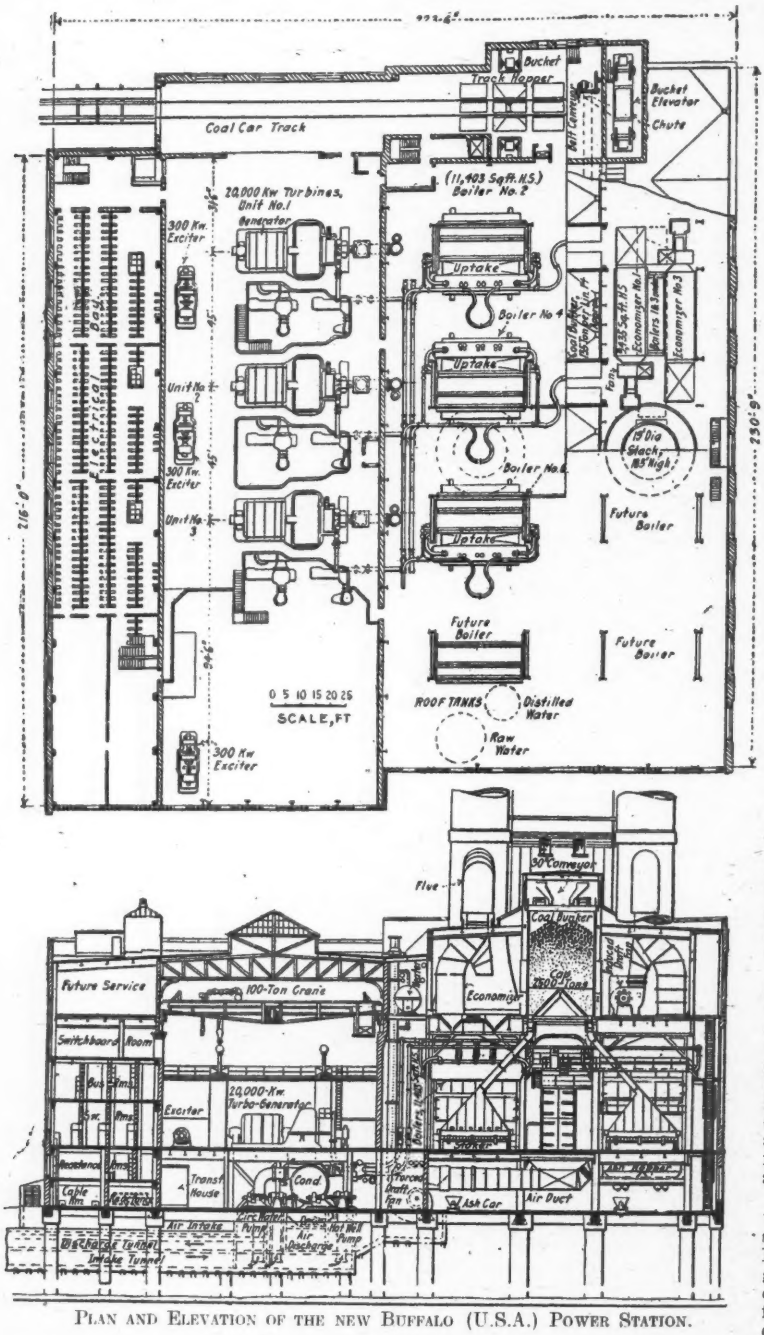
The stokers are of great size, the furnace width being nearly 24 ft., and the combined depth 13 ft. 4 in., giving a total grate area of 319 sq. ft. The distance from the top of the grate to the front header is 10 ft. 10 in., and from the top of the grate to the rear header 6 ft. Each stoker is driven by a 25-h.p. Sturtevant engine through link belt chains. Forced draught is supplied to the stokers by three fans, each driven by 300-h.p. geared turbines, the air being normally drawn from the main generator system.

The boiler setting walls are of firebrick, covered by ½-in. asbestos millboards and magnesia blocks 4 in. thick, the whole being enclosed in airtight steel casings, with removable

panels. The boiler fronts are of steel plate lined with 2½-in. magnesia.

When burning coal at the rate of 700 lb. per hour per stoker retort it is expected that each boiler will show an actual evaporation of approximately 140,000 lb. of steam per hour.

Each boiler is provided with a Green economiser of 9,435 sq. ft. heating surface in 576 12-ft. tubes, designed for a working pressure of 325 lb. The economisers are arranged in pairs over the firing aisles of the boilers, and are cased in steel with asbestos heat insulation; the soot is withdrawn by an ejector system. An induced-draught fan is installed at the exit of each economiser, giving a static pressure of from



Plan and Elevation of the new Buffalo (U.S.A.) Power Station.

.25 in. to 1.5 in., the power required varying between 1.8 H.P. and 130 H.P. The fans discharge into two superposed brick-lined steel stacks each 18 ft. in diameter inside and 185 ft. high above the grates.

The make-up water for the plant is obtained from the Niagara River, and distilled in an evaporating plant with a capacity of 15 tons of distilled water per hour; the guaranteed evaporation is 2.5 lb. per lb. of steam supplied. The apparatus includes a feed heater, a heat exchanger, a desuperheater, three evaporators, a condenser, and a special distiller for furnishing drinking water, with an aërating filter.

The use of distilled water was justified by the intention to run the boilers at high rates of evaporation, towards which absence of scale was a necessity.

The three turbines are of the single-cylinder horizontal Curtis type running at 1,500 R.P.M. The steam guarantees were: at 7,500 KW., 11.85 lb. per unit; 10,000 KW., 11.05 lb.; 15,000 KW., 10.25 lb.; and 20,000 KW., 10.60 lb.; the turbine rated capacity per sq. ft. of floor area is 24 KW.

Three 300-KW. exciters are installed, each coupled to an induction motor and steam turbine, the governing of the latter being so arranged that the turbine will pick up the load if the motor fails. The main turbines exhaust into 33,000 sq. ft. Westinghouse condensers, each of which has two 25,000-gal. centrifugal pumps driven by geared turbines, two turbine-driven hot well pumps, and one double Le Blanc dry-vacuum pump, also turbine driven. The condensate from the turbines is delivered to three 10,000-H.P. Cochrane horizontal heaters, which use the exhaust steam from auxiliaries, enough of which are run non-condensing to supply the necessary steam to give a normal water temperature of 160 deg. F., which is best suited for the economisers.

The exhausts are those from the turbines driving exciters and forced draught fans; boiler feed, low service, hot well, condenser water circulating and air removal pumps, which are, of course, free from oil, also the exhaust from the stoker engines, which is passed through an oil filter. The drips from the high-pressure steam piping and condensation from the station steam heating system are also led to the heaters, and should the water level in the latter fall below a fixed point, distilled water is allowed to enter through a float valve, while in emergency raw river water can be introduced.

Three 1,000-gal. per min. three-stage pumps driven by turbines force the feed water either direct or through economisers to the boilers, which it enters at 270 deg. F., the amount of water being automatically governed by apparatus controlled by the rise and fall of steam pressure in the pipe lines. Duplicate steel steam and feed pipe lines are installed, with cast steel fittings, valves, &c. The condensers are spring supporter, with no expansion joint between condenser and turbine, but rubber expansion tubes are provided in all water connections, &c., to the condenser. The stokers are provided with electric tachometers having two scales, showing speed of shafting and pounds of fuel per hour; stoker air pressure is also indicated, and recorders are installed for feed and flue gas temperatures and CO_2.

A 10-in. low pressure connection is provided on each main turbine to take surplus exhaust steam from the auxiliaries beyond that required for water heating. Solenoid-operated trips are connected with the main throttle, auxiliary throttle and vacuum breaker of each unit, so that the opening of the main generator circuit simultaneously shuts off all steam from the machine and destroys the vacuum.

The complete permanent testing plant is a feature of the station; a rotating dry vacuum pump is installed to allow of tests on the main condensers, which are operated with hydraulic dry vacuum pumps, and a gasometer to allow of volumetric tests being made. The testing plant for the station auxiliaries includes a 1,400 sq. ft. surface condenser, with a weir for measuring condensate, &c. An automatic coal sampling plant is installed in the coal elevator tower with a crusher, for each elevator.

The three alternators are each two-pole self-ventilating machines rated at 22,222 K.V.A., supplying three-phase, 25-cycle current at 12,000 volts direct to the bus-bars and outgoing lines. The electrical bay extends the entire length of the building, and has six floors containing the main switchboard equipment, of which a feature is the provision for a great number of outgoing feeders.

Each generator is connected through disconnecting and non-automatic oil switches to a reactor bus, and from the latter through 2 per cent. synchronising reactors and oil switches to a common synchronising bus, also through 5 per cent. generator reactors and non-automatic selector oil switches to sectionalised feeder buses in duplicate, one generator having its own feeder-bus section for 12 feeders. Each feeder has an automatic oil switch, and provision is made for feeder reactors. A length of 45 ft. per generating unit is provided in the electrical bay, and is separated by concrete walls from adjoining spaces. The neutral connection of the Y-wound generators is grounded through an oil switch and 5-ohm resistance. The generator leads are varnished cambric insulated, carried in concrete-cased fibre duct, and connected to strap-

copper buses, all main conductors beyond being of strap-copper separated by barriers. The main control board is of the Westinghouse vertical panel type. Direct current for oil switch operation and emergency service is supplied by a 60-cell battery of 200 amp. rating for one hour.

The late Mr. Henry G. Stott was the consulting engineer, and the Stone & Webster Construction Co. were the designers and constructors, under his direction, of this plant.

WAR ITEMS.

Power Station Volunteers.—At Philadelphia (Co. Durham), a power station platoon is being formed in connection with the County Volunteer Regiment.

Exports to Liberia.—The "London Gazette" for March 16th contains a lengthy list of persons and bodies to whom exports to Liberia may be consigned.

Trading with the Enemy.—The "London Gazette" for March 16th contains additions to, and corrections in, the lists of persons and bodies with whom trading is prohibited in Argentina and Uruguay, Bolivia, Brazil, Chile, Netherlands, Norway, Spain, Venezuela, &c.

Loans for New Works.—The Local Government Board explain that, by arrangement with the Treasury, they cannot sanction loans for new works except those of pressing necessity either for reasons of public health or on account of war requirements.—*Times.*

Station Staff Separation Allowances.—The Shoreditch B.C. Electric Lighting Committee has reported that the rate of Government separation allowances payable to wives and families of men serving with H.M. Naval and Military Forces having recently been increased in view of the additional cost of living, the question has arisen as to whether, in cases where the increased separation allowance is received by dependents of officers and men in the Council's employ, the Council's allowance should be correspondingly reduced. The Committee recognises that the increase in the allowances has been made solely on account of the increased cost of living, and recommends that, notwithstanding any increase in separation allowances in consequence of increased cost of living, the Council's present allowances to wives of men on active service be continued in all cases at the rates now being paid.

Restriction of Electrical Imports.—We learn from the *Journal* of the Tramways and Light Railways Association that the Board of Trade requested the B.E.A.M.A. to collect in detail and without loss of time the essential requirements for the home trade of the following electrical accessories for twelve months ahead:—

Bells (electric) and relays for same.
Adaptors for lampholders.
Fans (electric) and parts thereof.
Lampholders (with and without switches).
Electric lighting accessories, porcelain with metal fitments.
Cut-outs, round and oblong.
Ceiling roses, two-plate.
Counterweights, pulleys and rings.
Wall switches, tumbler and rotary.
Reflectors, metal and glass.
Brass and copper component parts for electric lighting accessories.
Electro-medical apparatus or material.
Telephone relays.

The secretary of the B.E.A.M.A. wrote to secretaries of the Tramways and Light Railways Association and of the Municipal Tramways Association, under date January 12th, 1917, stating: "In order that your members may not experience undue inconvenience through shortage, it is essential that they should provide this information as quickly and accurately as possible."

Birmingham Electrical Engineers Volunteers.—The services of the Birmingham Electrical Engineers (V.), attached to the Royal Naval Volunteer Reserve, are highly appreciated by the Admiralty, and their usefulness is fully recognised. Probably engineers throughout the country will be interested to know what the Corps is doing. Recruits are drawn from the following skilled trades: Turners and fitters (with experience in screw-cutting), electrical instrument makers and repairers, wiremen (with experience in turning and fitting), armature winders, coppersmiths, acetylene welders, blacksmiths, moulders (metal), carpenters and joiners, and mechanical draughtsmen. They are sent to depôt ships, where they are engaged in experimental and constructional work. Fifteen months ago the Corps made arrangements with the Admiralty whereby members were accepted for periods of temporary service, and the scheme was started by 10 Volunteers being sent to H.M.S. *Vernon* at Portsmouth. The numbers gradually increased, and the Admiralty was so pleased with the work done that it opened two more depôt ships—H.M.S. *Defiance*, at Devonport, and H.M.S. *Actaeon*, at Sheerness—to Birmingham recruits. Seventy Birmingham men are now on board these three depôt ships, but altogether 170 men from the Corps have served varying periods since January, 1916. Recruits skilled in the above trades are still needed urgently, and they can enrol either for continuous service or for service at regular intervals for not less than two weeks at a time. The pay for temporary periods of service is 17s. 6d. per week, with food and uniform, and for those who enrol for continuous service separation allowances will be available. Travelling expenses are paid by the Admiralty. The Corps provides a splendid opportunity for those who wish to do their duty to the country, but who are under or over military age, are physically unfit for military service, are discharged from the Army as unfit, or have been badged by the Ministry of Munitions. In the latter case the men may serve in periods, but they must obtain their employer's written permission to do so.

Mr. David Shanks, J.P., is Commanding Officer, and Mr. S. Thos. Pemberton, A.M.I.E.E., is Company Commander and Adjutant. Full particulars of the movement can be obtained from the latter at 8, Church Street, Birmingham.

Exemption Applications.—At the Shoreditch Tribunal, Mr. R. J. Jacobs, aged 30 years, of 94, Leonard Street, E.C., electric pocket-lamp manufacturer, came under review under the new Order, being under 31 years of age. He said he had been in the trade some time, but started this business in July, 1915, with the patriotic motive of trying to capture the German trade in these things. Mr. Harwood said he wished to point out that he started 12 months after the war. Captain Fisher said it was clear that that was the time when the electric pocket flashlamp came so much into use. In reply to Mr. Harwood, Mr. Jacobs said he got his machinery from America. He employed from 60 to 65 hands, but of these only four were males, two men and two boys. When he got the full amount of machinery he required he would be employing 100 persons. The demand was now much greater than it had ever been before. His brother, who was three years older than himself, had gone, and he was the only one left who could carry on the business. The Tribunal decided that it was a very necessary and prosperous business, and allowed another six months' exemption.

At Batley Tribunal, Mr. S. D. Jones, of the Corporation electricity department, applied on behalf of 14 men at the works. It transpired that one or two of the men were leaving and getting work elsewhere. The Chairman of the Tribunal questioned whether they had any right to do so, and Mr. Jones replied that the electricity works of Batley was not a certified or controlled place. They supplied power to munition works, but the Munitions Department would not give them a certificate as a controlled undertaking. A member of the Tribunal remarked that men between 16 and 61 were not allowed now to change situations without permission of the Director of National Service, and the Chairman added: "If anybody is retained, it should be in a place like yours." Mr. Jones said he had lost his chief assistant, who had gone away with the permission of the Council, and he had advertised and could not get a man to fill the position. The Military Representative said these men who were leaving would have to be followed up. Mr. Jones said he could not spare R. Greenwood (19), single, the junior engineer, as there was nobody to replace him. He was competent to take charge of machinery in the absence of the chief engineer. The Tribunal thought so young a man ought to be spared. Eventually the following were the decisions:—Conditional exemption, J. Brown, 35, single, stoker; A. Reid, 41, married, engine-fitter; J. D. Mosley, 40, married, cable jointer; S. Wadsworth, 36, married, stoker. Temporary exemption to May 15th: H. Hesling, 30, married, engine driver; P. M. Maxwell, 31, single, mains superintendent; F. Crossland, 37, married, jointer's mate. Grace to May 1st: R. J. Greenwood, junior engineer; A. Russling, 23, single, station superintendent. Disallowed, without grace: J. Ainscough, 36, married, shift engineer; I. Gill, 30, married, labourer. Adjourned for medical examination: S. J. Kench, 26, single, clerk; J. Allerton, 39, married, general labourer; J. Monoghan, 33, married.

At Faversham, the Corporation appealed for W. J. Lloyd (29), engine driver and switchboard attendant at the electricity works, and H. J. Gregory (28), switchboard attendant. The Military Representative asserted that there had been sufficient time to get substitutes or to train men for the work, but the electrical engineer (Mr. Sommerville) replied that when he consulted the Labour Exchange there was not a man available. A final two months was granted in each case to give an opportunity to train other men.

At Folkestone, 12 employés were appealed for by the Electric Light Co., and conditional exemption was granted to the engineer-in-charge of the power house, two fitters, a commercial and analytical clerk, a stoker, and a confidential clerk. The others were exempted unless and until substitutes could be found.

At Hastings, the Corporation electricity department claimed the retention, as being indispensable to the running of the works, of E. A. Down (18, in B 1), junior engineer, and J. G. Francis (18, B 1), apprentice in the meter test room. Mr. R. F. Ferguson said that the works were run with a staff down to the absolute limit, and men capable of doing the work could not be got. Two months were allowed in each case.

At Oxford, the Military appealed against exemption granted last May to W. G. Payne (29), electric fitter and wireman with Messrs. Hill, Upton & Co., electrical engineers. For the firm it was stated that Payne was engaged nearly the whole of his time on Government contracts, and often for

seven days a week. He was the only skilled man on the present work of installing the electric light at Christ Church, and at Pembroke, for the Royal Flying Corps, and when that was finished he had other military work at the base hospital and New College. Out of 24 men, the firm had only four left, and they had 11 female employés. Captain Fox said that the man's qualifications would make him useful in the Army. The certificate was withdrawn, with a month's grace.

At Gloucester, the Corporation electricity department appealed for two tramway motormen. It was stated that there was a considerable shortage of motor men, and that it was impossible to obtain candidates for instruction. The Military contended that both men could be spared if the Westgate Street route was again closed down. One of the men was conditionally exempted, and the other appeal was refused.

At Bexhill-on-Sea, the Corporation applied for exemption for two shift engineers at the electricity works, aged respectively 21 and 22. Mr. Frost stated that substitutes had been advertised for, and out of three applicants only one was of use to them. A woman, he added, would be no good. The appeals were respited for a month for substitution.

The Military applied, at Reigate, for a review of exemption held by R. Partridge (34), electrician, with Messrs. Tamplin & Makovski; electrical engineers. Mr. Makovski said that Partridge was his principal outdoor man, and they had a large amount of Government and public work on hand. He told the Tribunal that last May one of his employés was called up, but he was sent back and told to wait. He hung about until November, and he then got his Trade Union to get him badged. He was now with a competitive firm hanging lights at Holborn, work which his own firm should have done. The Tribunal cancelled the certificate, and gave temporary exemption until June 13th.

At Aldershot, on March 12th, a review was made of the case of F. Woodley (27), electrical engineer, with Messrs. Burch & Vertue. It was claimed by the firm that he was engaged entirely upon electrical work in the Aldershot Command, and that he was doing National Service. The Chairman (Mr. W. T. Robertson, J.P.) said that if the man's services were so valuable to the military, it was up to the military to find a man to do the work. The exemption was withdrawn.

At Stratford-on-Avon, an appeal was made by J. Clifford (27), formerly an electrical turbine worker at the works of the British Thomson-Houston Co., Ltd., at Rugby. It appeared that he left when de-badged, and recently was given 14 days in which to obtain work of national importance, the idea being that he could get reinstated at Rugby, in which case he would be given exemption. It was stated that the B.T.H. Co. were willing to reinstate Clifford, providing the Tribunal granted exemption. This was conceded, but the Military threatened an appeal.

Before the Dartford Rural Tribunal, the Military appealed against exemption held by F. W. Montgomery, electrician with the Wallpaper Co., on the ground that he was now in an uncertified occupation. The firm urged that it was most important that a competent man should be in charge of their large plant, as two men had been electrocuted. It transpired that, by arrangement, the firm had released all men who could be spared, and the Tribunal dismissed the appeal.

The British Mechanical Electric Vehicles, Ltd., applied at Southport Tribunal for exemption for J. E. Stott, Group 40, passed B 1, manager and designer of electric trucks. A director of the firm said their's was the first British company of that kind, and the Ministry of Munitions had given them permission to manufacture these trucks for railway and shipping companies. There were some 3,300 of such trucks in use in America, but under 300 in Great Britain, and he came from Australia to start the industry in England. Exemption to April 16th granted.

Mr. A. S. Black, Corporation electrical engineer, appealed at Southport, on Friday, for W. Johnson, nearly 41, a skilled man engaged in the maintenance of consumers' installations; J. Hesketh, storekeeper, C 2, and R. A. Twist, meter tester, B 2. The appeal for Twist was refused, and others were given exemption to June 1st.

THE PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

On March 12th Messrs. Gill and Cook's paper was read and discussed before the Newcastle Local Section of the Institution of Electrical Engineers.

Mr. Gill, in introducing the paper, said its object was to arrive at a solution of the principles by which the cost of depreciation could be arrived at. They were, at the moment, concerned with the ascertainment of depreciation, and not how it was to be met. It was an actual cost, and there should be some common method of arriving at it.

Mr. F. G. C. Baldwin thought the paper solved many of the difficulties that had confronted them for several years. He was especially pleased to see it stated that depreciation affected the design of plant. There was a general tendency amongst those who controlled capital to look first to capital cost and then to charges. He agreed that it might be advantageous to spend extra capital to reduce annual charges. Too often that was disregarded. Engineers should be a little more interested in the financial aspect of the business than at present.

Mr. Turnbull referred to the Telephone Arbitration, and pointed out that in that case the "straight-line" method of deprecation was accepted. He also referred to the way the railway companies had treated the question, and asked Mr. Gill's opinion in regard to "negative" depreciation. In the case of the adoption of the sinking-fund method, he thought some allowance should be made in the early years of an undertaking.

Mr. A. C. Hovey, speaking from a gas engineer's point of view, thought there should be greater co-operation between the accountancy and the engineering departments. He mentioned that large gas undertakings, on going to Parliament for new powers, were being severely dealt with, especially in respect of anything they asked for in regard to improved methods of finance. In some cases the renewals funds had been struck out, and would not be allowed in future. They were very necessary and important funds, and it seemed a great pity they should have been done away with.

Mr. Beard said he thought the sinking-fund method must be the right one; he was of opinion, however, that there might be some difficulty in arriving at the "life" of some plant. He did not see how the economic life of plant could be estimated; also, the amount to be put to depreciation fluctuated year by year, and by altering it they were able to keep the rate of interest more uniform, paying more to depreciation one year and less the next.

Mr. Nicholson commented on one of the "essential conditions" in the paper, that the plant should be charged with a yearly sum sufficient, *inter alia*, to provide the money to enable the company to take advantage of improvements, and take out of commission, when desirable, plant which still had some years of life left in it, and questioned the effect of the operation on the sinking fund.

Mr. Gill, in reply, said that while there was difficulty in estimating the life of plant, it was not more difficult than to estimate the life of a person; and yet insurance societies throve on the latter. In the case of plant upon which money had to be spent to bring it into commission, the cost should be charged to revenue. As to the engineer's knowledge of finance, it seemed to him that the engineer ought to endeavour to appreciate his responsibility in regard to finance more. It was he who ultimately selected the plant, and the plant was put down on his calculations and estimate, and the engineer, in putting down the plant, practically settled the dividend; therefore the dividend was fixed, depreciation was really fixed because it depended on the kind of plant put down, and the operating costs were fixed. If the engineer was going to do his duty he must take up the question of finance. As to the suggestion that some allowance might be made in the early days of an undertaking, some such course was often pursued, but it hardly touched the principle of the paper. The way to do was properly to estimate the depreciation, and then carry it forward as a debit.

REVIEWS.

The Emission of Electricity from Hot Bodies. By Prof. O. W. Richardson, F.R.S. London: Longmans, Green & Co. Price 9s. net.

This work is one of the monographs on physics edited conjointly by Sir J. J. Thomson and Prof. Horton. In its 300 pages it gives a very complete account of what is known at present on the emission of electricity from hot bodies, a subject which has of late years received much attention, and which is making wonderful progress. There are many difficulties encountered in its investigation, and the author states that the absence of a satisfactory and comprehensive theory of conduction for conductors of the metallic type, and the interpretation of the facts bearing on the true nature of the contact potential difference between metals are not the least. Then there are experimental troubles of various kinds, and the difficulties of the correct recognition of results.

Prof. Richardson puts the electronic theory of conduction and its inference with regard to electronic emission in a succinct and convincing way. He says: "According to theory, the conductivity of metals arises from the presence in them of an atmosphere of electrons. These are supposed to be in violent motion, like the molecules of a gas according to the kinetic theory of gases. The effect of an applied electric field is to superpose on the haphazard heat motion of these electrons a definite average velocity of drift in the direction of the electric potential gradient. This drifting of the electrons constitutes the electric current. The energy of the heat motion of these internal 'free electrons,' as they are often called, will increase with rising temperature; and one might expect that at sufficiently high temperatures this energy would be great enough to carry them out through the surface of the hot body. From this standpoint, the escape of negative electricity from hot bodies is closely analogous to

the escape of the molecules of a vapour from a solid or liquid during evaporation. It is, in fact, a kind of evaporation of electricity."

In the first chapter the author discusses considerations of a general character, and gives a historical review of the subject. Elster and Geitels' investigations of the 'eighties of last century are gone into. Then the theory of ions, the properties of the gases drawn away from the neighbourhood of incandescent bodies, the specific charge of the ions, general experimental methods, relation between the currents and electromotive force and gas pressure, and the electron theory are discussed in turn with a view to a better appreciation of the more detailed work which follows.

Some idea of the difficulties involved in the investigation of electronic emission can be glimpsed by the fact of the existence of the two schools of thought with regard to the magnitude of contact difference of potential between metals whose surfaces are free from gas and in a good vacuum. One school has it that these differences are accounted for by chemical action between metals and the surrounding atmosphere, and the other looks upon them as the intrinsic properties of the metals affected. Most of those who have experimented have up to recently favoured the chemical theory. But in 1912 the author showed that in all experiments hitherto performed secondary actions occurred which enabled the results to be explained on the intrinsic theory just as well as on the chemical. And, moreover, a lot of new evidence has lately come to hand which actually favours the intrinsic theory.

There is a long and comprehensive chapter on the temperature variation of electronic emission. The author and many others have experimented in this field, and although there is much difference of opinion in the final interpretation of the experimental results, there is none as to the fact of the general character of the variation of the rate of emission of the electrons by various hot bodies with temperature. In all cases experimenters have found that, under stable conditions, the rate of emission of electrons increases extremely rapidly with increase of temperature. Towards the end of the chapter there are a few pages on the emission of electrons from various compounds, and on photoelectric emission. Because with the high rise of temperature all substances give out light, an emission of electrons from hot bodies owing to the action of light occurs, even when there is no external source of light illuminating them. The author calls this the autophotoelectric effect. Hence, it is of the utmost importance to settle whether thermionic emission is due to photoelectric action or not, and the investigation is very troublesome. The author states that all the indications available point to the conclusion that the autophotoelectric currents are smaller than the observed thermionic currents, although an absolute verdict is impossible at present.

There is much interesting work on the effect of gases on the emission of electrons, the cases considered being the emission from platinum in an atmosphere of hydrogen, and the effects of various gases on the emission from tungsten; then there is a discussion on the relative importance of various factors in causing emission, and an analysis of the chief causes of confusion. The chief factors are: (1) the escape of electrons owing to the purely thermal increase of their kinetic energy, (2) the liberation of electrons as one of the products of chemical action, and (3) the complete photoelectric emission. The relative claims of purely thermal effect and of chemical action are dealt with at some length. The question is most involved. The author details experiments he has made on tungsten, and gives it as his considered judgment that they definitely exclude chemical action as the cause of the emission from this substance. This is supported by the results of Langmuir, who finds that with tantalum, molybdenum, carbon, and platinum, as well as tungsten, the emission is increased with progressive elimination of gaseous contamination and corresponding freedom from liability to chemical action.

Chapter V deals with the energetics of electron emission, involving the kinetic energy of the emitted electrons, latent thermal effects, and heat liberated during electron absorption.

Other subjects dealt with are the emission of positive ions by hot metals, the effect of gases on the liberation of positive ions by hot metals, and the emission of ions by heated salts.

In the last chapter, the author has included a short account of the results of some experiments he has recently made on the electrons liberated by chemical action. Part of the cost of this investigation was defrayed by a Government grant through the Royal Society.

There is no doubt whatever that the work under review is a valuable addition to the literature of the subject. It gives a most comprehensive statement of what has been so far accomplished; it states the results of investigation of many workers of the past; and it brings up experimental research to practically the present moment. The author has a pleasant habit of being able to summarise where necessary, and to expand where necessary. His judgment is always keen.

Electrical Measurements and Testing: Direct and Alternating Current. By Chester L. Dawes. New York, U.S.A.: John Wiley & Sons. Price 3s. net.

The Wiley "Technical Series" includes a loose-leaf laboratory manual, and this series of 40 sheets comprises the section on electrical testing. Each sheet gives detailed experimental instructions as to the apparatus to be used and the procedure to be adopted, and concludes by putting a number of questions relevant to the experiment performed. Occasional notes and cautions are included to prevent beginners falling into the usual errors, and most of the sheets give clear and workmanlike directions which, if followed, would lead to satisfactory results. Clearly-drawn diagrams are used to illustrate the text, and in most cases these would suffice to ensure that suitable instruments were used and correct connections made.

The most important experiments described are those which deal with such essentially practical questions as potential drop in feeders, commercial potentiometers, operation of the various types of D.C. and A.C. generators and motors, transformer connections, and the operating characteristics of rotary converters. Some elementary sections are devoted to connections for batteries, bells, gas lighters, &c., but the majority of the sheets deal with real electrical engineering problems.

The method of numbering the sheets appears to be unduly complicated, and, although there is much that is useful and satisfactory, it is probable that most electrical engineering laboratories possess similar sets of instruction sheets, and will not be tempted to adopt Mr. Dawes's methods in preference to their own.

The experiments have apparently been chosen to illustrate Timbie's "Electrical Measurements in Alternating and Direct Current," and Karapetoff's "Elementary Electrical Testing"—two books which are common enough in the States, but seldom seen in this country. It is, therefore, very likely that, whereas Mr. Dawes's students at Harvard will "enthuse" over this manual, it will attract little attention, and less sale, on this side of the Atlantic.—P. H. S. K.

BUSINESS NOTES.

Patents and Alien Enemies.—Application has been made by Messrs. Edward Bennis & Co., Ltd., to the Board of Trade to avoid or suspend Patent No. 5,041/13, granted to L. & C. Steinmuller, for travelling grates for furnaces.

Trade Announcements.—Messrs. Simplex Conduits, Ltd., of Birmingham, have recently enlarged the accommodation at their showrooms and warehouses at 113-117, Charing Cross Road, to give the trade an improved "Simplex Service" in London and the South of England. The warehouse on the basement will continue to carry the stores of conduits and fittings, and on the ground floor the showrooms are being extended as time and convenience permit. On the first floor of the building there will be the offices of Mr. L. M. Waterhouse, the managing director, of Mr. Bennett, the London and South of England manager, and of the general office staff of the London sales department. On the second floor there will be a trade counter for accessories, such as electric light fittings, heating and cooking apparatus, lamps, and cables. Stocks are warehoused on the upper floors.

Messrs. John Moores & Co., New Bailey Street, Salford, have removed to Brougham Street Works, Blackfriars Road, Salford.

Dissolutions and Liquidations.—Anchor Electric Co., Ltd.—This company is winding up voluntarily, with Mr. T. T. Rankin, of Anchor Electric Works, Chadwell Heath, Essex, as liquidator. Meeting of creditors March 30th, at 5, Lincoln's Inn Fields, W.C.

Coventry Magneto Repairing Co., 9A, Fleet Street, Coventry.—Messrs. W. V. Wakefield & C. F. H. Foster have dissolved partership.

Condensing Plant.—The Mirrlees Watson Co., Ltd., Glasgow, have recently received orders for 69 sets of condensers, practically all for war-service work, aggregating approximately 1,400,000 lb. steam duty per hour.

Catalogues and Lists.—Messrs. Dick, Kerr & Co., Ltd., Abchurch Yard, Cannon Street, London, E.C.—Card giving prices of Britannia drawn-wire lamps.

Messrs. Brayshaw Furnaces and Tools, Ltd., Mulberry Street, Hulme, Manchester.—Illustrated circular showing several views of furnace installations supplied by them. In their new demonstration room at the works they have put down their latest types of furnaces for the heat-treatment and annealing of steel, the melting of metal, &c.

Swedish General Electric, Ltd., 5, Chancery Lane, London, W.C.—Current Stock List No. 10, giving particulars of electric motors, from ¼ to 50 H.P., that they have in stock.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—Handbook No. 2 in the company's series of incandescent electric lamp handbooks. In the course of its 68 pages it gives very full information and technical data relating to lamps for battery service (20 volts and below) for automobiles, general batteries, flashlight lamps and surgical lamps, and dimensional drawings of all lamps and the lamp caps. Electrical traders and trade users can have copies of the handbook on applying to the company's L. and W.S. department.

Messrs. S. G. Leach & Co., Ltd., 26-30, Artillery Lane, London, E.C.—Illustrated price list (LM 5), giving particulars of portable and stationary air compressors.

Bankruptcy Proceedings.—W. D. Birkett, factor of electrical goods, Whitley Bay.—Trustee released, March 2nd.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LV, No. 264. March, 1917. This issue contains the following papers:—"Frequency Changers," by Mr. R. Townend, and "Telegraph Poles in New Zealand," by Mr. J. Orchiston.

LIGHTING AND POWER NOTES.

Barnsley.—Proposed Loan.—The T.C. has approved the recommendation of the Electricity Committee to apply for permission to borrow a further £4,000 in connection with extensions at the electricity works. The extra expenditure, it was reported, had become necessary owing to the abnormal period, but the outlay would be justified.

Bedford.—Plant Extension.—The Electricity Committee reported that the B. of T. had given its consent to the supply of electricity to a works outside the borough, and that the L.G.B. had sanctioned the following loans without a public inquiry:—Buildings, £8,450: boiler house plant, steel chimneys, pumps, turbo-generator, engine room accessories, switchgear, and transformers, £20,711; mains, £1,502; mechanical stokers, £1,140; coal bunkers, £900; a total of £32,703. Consent has been obtained from the Midland and London and North-Western Railway Companies to the laying of cables across their respective bridges.

Brighouse.—Year's Working.—There has been a gross profit of £1,013 on the working of the electricity undertaking for the year ended March 31st, 1916.

Bristol.—Price Increase.—The T.C., on the recommendation of the Electricity Committee, has increased the charges for electricity to general consumers, as from the last readings for the current quarter, by a further 8½ per cent., thus making altogether an advance of 33⅓ per cent. on the scale charges for both light and power.

Canada.—Sir Adam Beck, in giving information relating to the Ontario hydro-electric system for the year ending October 31st, 1916, says that the total average H.P. used in the system was 109,583, at an average cost of $9.10 per H.P. The total receipts were $2,038,792. As regards the Severn system, the total expenses, including generating, amounted to $54,438, and the revenue to $94,694.—*Canadian Engineer.*

Clayton.—At a special meeting of the D.C., last week, a letter was submitted from the Yorkshire Electric Power Co., intimating that March 20th was the date for hearing objections against the company's Bill for powers to supply certain districts, including Clayton, with current, and asking that, in view of the strong opposition of the Bradford and Halifax Corporations, the Council should send a representative to give evidence in support of the Bill. It was decided, after discussion, not to send a representative, but to send a copy of the Council's resolution agreeing to support the company's Bill.

Continental.—France.—La Société des Forces Motrices de la Durance is the name of a new undertaking which has recently been formed in Lyons (9, Rue Grolee), with a capital of £600,000, to establish a plant to utilise three waterfalls on the River Durance in the generation of electrical energy for lighting and power purposes.

Italy.—A Supreme Council for Public Waters has now been established as the chief administrative authority in all matters connected with the development of water power in Italy. The chief duties of this new organisation are:—(1) to draw up a list of all the public waters of Italy; (2) to examine and verify existing rights; (3) to discuss and decide on schemes submitted for concessions to develop and apply public waters for use as motive power and in factories.—*Board of Trade Journal.*

Cronton.—The electrical equipment of the Hulton Co.'s new collieries at Cronton, near Rainhill, is now practically completed.

Cuddington.—E.L. Proposals.—The Epsom R.D.C., after discussing the E.L. schemes of the Wimbledon T.C. and the South Metropolitan Electric Tramways and Lighting Co., has decided to consent to the prov. order for the latter, subject to a sealed agreement. The company proposes to supply energy to South Cuddington, whereas the Wimbledon Corporation could not supply without a guarantee, for at least two years, of 20 per cent. per annum on the outlay incurred.

Dublin.—The Electricity Supply Committee has reported that the estimate for the ensuing year requires no demand on the rates. The secretary reports that, after making allowance for the small income from temporary premises of consumers affected by the Rebellion of last year, the net loss to the undertaking amounted to £7,000. A serious item was the special amount for extra capital charges entailed by the calling in of one of the loans, and the compulsory issue of Corporation stock to meet same.

Folkestone.—The T.C. has decided to have a permanent system of electric lighting installed at the Museum.

India.—The Madras Administration P.W.D. Report for 1915-16 states that the necessity for economy owing to the war has restricted the operations of the Department. As regards electrical schemes and works, the Coimbatore and Pykara hydro-electric schemes were both under consideration, the former for the supply of electricity to the town of Coimbatore, from the Siruvani River, and the other for the supply to Ootacamund from the Pykara Falls. The latter has been held in abeyance pending some decision regarding the Siruvani scheme, the possibilities of which had to be further considered in view of the decision of the South Indian Railway to erect large workshops at Podanur. There are quite a large number of installations in progress or under consideration, chiefly in connection with public buildings and offices in Madras. During the year under notice the number of consumers increased from 1,777 to 2,009, and the electricity consumed from 4,704,000 units to 5,586,609 units. With a view to meeting the increasing demand in Madras City, extensions of the alternating-current system were projected for the suburbs of Kilpauk and Royapuram, but the schemes have been indefinitely hung up, owing to the impossibility of getting materials from England on account of the war.

An accident having occurred by which a visitor was nearly electrocuted at a friend's house lately, owing to a leakage of the electric current to a bath tap, the Mysore Government has now ruled that no interior wiring for power and light in Bangalore and Mysore shall be carried out by a contractor who is not the holder of a licence issued by the Electrical Department.—*Indian Textile Journal.*

Leigh.—Messrs. Speakman have had a generating station built at their Woodend Collieries, where developments are taking place in connection with the opening of new mines.

London.—Poplar.—The interconnection of the Council's undertaking with that of Hackney was completed on February 12th, and a supply for the northern district has been taken since that date, materially assisting in reducing the pressure on the Poplar undertaking in meeting the demands of Stepney. The Stepney Electricity Committee wrote expressing appreciation of the help the Poplar Committee had rendered during the abnormal difficulties which it had, and is, experiencing with regard to the steam supply at Limehouse.

The electrical engineer's report for the December quarter shows that the total units sold were 6,231,591, an increase of 218,590 units over the corresponding quarter last year; the net surplus income is £4,224, a decrease of £921. The net profit from April 1st to December 31st is £7,519, as compared with £8,503. The net surplus estimated in March last was £5,383, and the £7,519 is due almost entirely to the lower coal prices actually obtained than were estimated for.

The Electricity Committee has approved the sale of two 500-kw. Willans reciprocating sets for £2,500; their removal will make room for another large turbine generating set at a later date without extension of the station. The sale of these sets necessitates the provision of a new converter, and the engineer is to provisionally accept a firm tender subject to sanction.

Woolwich.—At the B.C. meeting last week, held to consider the annual estimates, the Electricity Committee reported that no loss is anticipated for next year, the only amount necessary to be raised being the approximate deficit at March 31st in respect of the present year—namely, £2,986. The chairman of the Finance Committee stated that the electricity department seemed to have turned the corner, and its income balanced its expenditure.

L.C.C.—The Finance Committee recommends the Council to sanction the borrowing of £5,141 by the Islington B.C. for electricity purposes; the Council's application was for £5,499.

Westminster.—The Contracts Committee of the Council reports having considered the contracts with the Charing Cross, the Metropolitan E.S., and the St. James's E. L. Companies for the supply of electrical energy to the Council's buildings. The Committee went into the question of the advisability of substituting gas lighting in the buildings now supplied with electricity, but it was decided, having regard to the high cost of labour and materials and the circumstances generally brought about by the war, that it is inadvisable to pursue the question further at the present time; the three contracts are therefore to be continued.

St. Pancras.—It has been agreed to remove the two old Babcock boilers at the destructor works when the new Niclausse boiler at the electricity works is installed. The Finance Committee anticipates that the profit from the electricity department for the year ending March 31st will be upwards of £10,000.

Monaskweven (Co. Kildare).—E.L. Scheme.—A public meeting has taken the initial steps to provide electric lighting for the town, a scheme submitted by Mr. Griffiths, electrical engineer, being approved. Mr. Griffiths has already obtained the County Council's permission for the erection of the necessary poles.

Morecambe.—Proposed Loan.—The T.C. has agreed to apply for sanction to borrow £6,000 for the extension of the electricity works after the war.

Newcastle-under-Lyme.—Female Labour.—As an outcome of suggestions made at the Tribunal, the T.C. has referred to the chairman of the Electricity Committee and the electrical engineer, with power to act, the question of introducing female labour at the electricity works.

New Zealand.—Hydro-Electric Schemes for the North Island.—The Minister of Public Works states that investigations are being made in connection with proposals to install hydro-electric power in the North Island. It is thought that three

generating stations will be necessary, on account of the large and rough area over which it would be essential to run transmission wires. Surveys are being made in the Auckland district for the purpose of harnessing the Waikato River; the other two stations will probably be located in the Manawatu and Waikaremoano districts. It is also stated that, at a conference held recently of about a dozen local bodies in the Auckland district, including the North Shore boroughs, it was unanimously decided to urge the Government to provide hydro-electric power in the Province of Auckland, owing to its substantial increase of population and rapid development. It is estimated that if an up-to-date scheme, costing from £200,000 to £300,000, were introduced, a saving of no less than £50,000 a year could be effected in Auckland and suburbs.—*Board of Trade Journal.*

Rotherham.—Proposed New Power Station.—The Council has decided to make application to the L.G.B. for sanction to borrow £400,000 for the erection and equipment of a new power station.

Surbiton.—Price Increase.—Subject to the consulting engineer, Sir John Snell, being satisfied that the existing conditions justify an alteration, the D.C. has decided to increase the maximum charge for electricity supplied in the district from 7d. to 8d. per unit.

Swansea.—The electrical engineer reports that the approximate cost of the necessary cable, &c., for the supply to the new pumping station of the waterworks department at Cwmbwrla would be £1,200, of which the waterworks department has agreed to pay 7 per cent. per annum, or 20 per cent. of the capital outlay, by way of payment for energy consumed. The electrical engineer suggests that the charge should be 1½d. per unit, varying on a sliding scale agreed upon, the actual amount depending on the load factor of the plant.

Taunton.—Price Increase.—The T.C. has decided to increase the charges for electricity by a further 8½ per cent., making altogether an advance of 33⅓ per cent., on the scale charges for both lighting and power.

Worcester.—The city electrical engineer has recently pointed out the necessity of increasing the boiler plant, and advised the installation of a new boiler, at a cost of £4,350, which would result in a considerable annual saving and facilitate the work of cleaning the existing boilers. The Electricity Committee decided to postpone the matter, but the Council has referred the question back for further consideration.

The Electricity Committee recommends that the price of electricity for lighting be increased from 4½d. to 5d. per unit, and that it be made obligatory on consumers on the rateable assessment tariff to put in a heating or cooking device capable of consuming one or two units per hour, according as the rateable value is below or above £30.

Weymouth.—Loan Sanction.—The L.G.B. has given the T.C. permission to borrow £5,560 for cables, and £1,050 for switchgear and boosters.

TRAMWAY and RAILWAY NOTES.

Atherton.—The South Lancashire Tramways Co. has applied to the U.D.C. for consent to take up the rails in Bag Lane, and the Council has decided to consider the matter at its next meeting.

Dublin.—Messrs. John J. Clancy and John O'Connor, M.P.'s, have joined in the representations that are being made to the B. of T. for the taking over by the State of the Dublin and Lucan Electric Railway, and Sir A. Stanley has promised to intimate to them the nature of any objections that may be lodged. The claim of the railway employés to better conditions is one of the reasons influencing those who wish to have the line taken over.

Glasgow.—Accident.—On Saturday night a Corporation tramcar collided with another at Glasgow Cross, causing it to leave the rails and knock over an electric section box on the pavement. Some of the connections in the box were broken, with the result that the car became electrically charged, and several of the passengers suffered from shock, and were unable to leave until assisted by officials, who were protected by rubber gloves.

Hull.—Tramway Power Supply.—It is proposed, owing to the age of certain of the plant in the Osborne Street tramway generating station, to transfer a part of the load to the electricity department's Sculcoates Lane plant, where it is intended in the near future to install an additional 5,000-kw. turbine set. It is proposed then to lay the necessary cable and install converting plant at Osborne Street, the old plant in which will be disposed of by degrees.

Keighley.—War Bonus.—The offer by the Corporation War Bonus Committee of a bonus of 3s. to employés over 21 years of age and of 1s. 6d. to employés under that age, has been declined by the tramway workers, who have now put in an application for a war bonus of 6s. per week and to have themselves put on the same scale of wages as applies in Bradford. It is understood that they intend to take the matter to arbitration if the demand is not complied with promptly.

London.—L.C.C.—The Finance Committee recommends that the question of expediting the repayment of the debt in respect of obsolete capital expenditure outstanding on the horsed tramways be postponed for a further three years, or earlier if and when there is any surplus available after the renewal funds shall have been made up to the full amount necessary on the basis agreed upon.

Owing to unforeseen circumstances, the Bakerloo service over the L. & N.W. line to Watford will not be available on April 2nd, as announced, and it is expected that there will be a further delay of about a fortnight.

Newcastle-on-Tyne.—When the estimates were considered by the City Council, last week, Councillor R. Mayne (chairman of the Tramways Committee) announced that it might be found possible to open the reserve fund and find some money, if the Council desired it, to prevent any increase in the rates.

Rawtenstall.—Recently Councillor Barnes asked how the Tramways Committee's application for a sum of £3,000 for tramway purposes during the year was made up. Ald. Coupe replied that there was an all-round increase in expenditure, and they had to pay more interest on money borrowed and more rates, the interest, &c., showing an increase of about £1,500. They wanted each year to bear its own burden, instead of carrying the extra cost over and allowing it to accumulate.

South Lancashire.—Female Employes.—The women employés on various tramway systems which were affected by the award of the Committee on Production have given notice that they will cease work at the end of 21 days, failing an extension of the award to them.

Southend-on-Sea. — Female Labour. — The efforts which have been made to secure male drivers have only resulted in six being appointed; as 33 more drivers are required to maintain the service, arrangements have been made for the instruction of women drivers. In future all drivers, while being instructed, are to receive wages at the rate of 3d. per hour during a period not exceeding 14 days, and subject to the condition that they continue in the Corporation's service upon becoming qualified to drive. The wages of women drivers are fixed at 6d. an hour, and a woman inspector is to be appointed to supervise all female conductors and drivers.

Southport.—Ald. Griffiths, in moving the adoption of the Tramways Committee's minutes, referred to the vast increase in working expenses, and said that in spite of this they had not raised their fares. If they found it necessary to raise the fares to not more than 1d. per mile, he hoped they would have the support of the public.

TELEGRAPH and TELEPHONE NOTES.

P.O. Tube Railway.— Up to March 31st last a total of £355,497 had been spent on the underground railway which is being constructed in London for the conveyance of mails. At that date the unexpended balance of the authorised expenditure on the undertaking was £744,503.—*Daily Telegraph.*

Storm Damage. — Great damage was done by recent gales to telegraph and telephone wires on the moors around Huddersfield, and between Huddersfield and Manchester and Huddersfield and Brighouse. On the Manchester Road, over Standedge Hill at Marsden, four telegraph poles were completely broken off about a yard from the ground, and many others were forced out of the perpendicular, with a breakage and intermixing of wires which made communication between Huddersfield and Manchester by that route quite impossible. Residents expressed the opinion that the gale was the worst for 30 years.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare. — U.D.C. Electricity Department. Battery of accumulators, complete. See "Official Notices" March 16th.

Birkenhead.—April 3rd. Corporation Electricity Works. Washed and unwashed rough slack and coke breeze for a year. The Electrical Engineer, Craven Street.

Bray. — April 3rd. U.D.C. Stores for electric light works. See "Official Notices" to-day.

Dundee.—March 28th. Corporation. Twelve months' supply of electrical stores, &c. Specifications from the Electricity Department, Dudhope Crescent Road.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

Hull.—April 12th. Electricity Committee. Cooling towers. See "Official Notices" to-day.

London.—ST. PANCRAS.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

L.C.C.—The Council is recommended to invite tenders for the provision of cables and switchgear in connection with the supply of additional power in the Woolwich district.

Manchester.—March 26th. L. & Y. Railway. Various stores, including (32) signal, telegraph, and electric fittings, (33) signal, telegraph, and electric light wires, for 12 months. Mr. Waring, Stores Department, Osborne Street, Manchester.

April 3rd. Turbo-alternator and condensing plant for Stuart Street generating station. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Spain.—April 20th. Municipal authorities of Segovia. Concession for the electric lighting of the town. New invitation of tenders.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" March 16th.

April 11th. Electricity and Tramways Committee. Motors and transformers. See "Official Notices" to-day.

CLOSED.

Australia.—P.M.G.'s Department, N.S.W.:—

20,000 glazed earthenware conduits, two ducts; 5,000 ditto, three ducts; 9,000 ditto, four ducts; 5,000 ditto, six ducts; £4,439.—Brunswick Brick, Tile & Pottery Works Pty., Ltd.

P.M.G.'s Department, South Australia:—

10 miles twisted-pair, insulated wire, £22 15s. per mile; 30 miles ditto, £33 10s. per mile; 30 miles ditto, £23 15s. per mile; 5 miles ditto, single, £11 5s. per mile; 8 miles twisted conductor wire, £13 15s. per mile; total £2,111.—Callender's Cable & Construction Co., Ltd.

—*Tenders.*

Barnsley.—Electricity and Lighting Committee. Supply of 50 tons of coal per week, delivery between February 16th and June 30th: Messrs. J. Wilby, Ltd.

Government Contracts.—List of new contracts placed during February, 1917:—

WAR OFFICE.

Electric cable and wire.—Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; St. Helens Cable & Rubber Co., Ltd.
Electric cells.—Premier Accumulator Co., Ltd.
Air-compressor sets.—Broom & Wade, Ltd.; Lacey-Hulbert & Co., Ltd.
Conduits and fittings.—Barton & Sons, Ltd.; Credenda Conduits Co., Ltd.; Eureka Conduits & Fittings Co., Ltd.; General Electric Co., Ltd.; J. Griffiths & Sons; Oriental Tube Co., Ltd.; Simplex Conduits, Ltd.
Motor-converters.—Bruce Peebles & Co., Ltd.
Electric light fittings.—Edison Swan Electric Co., Ltd.; Johnson and Phillips, Ltd.; G. Roe & Sons.
Generating sets and parts.—Aster Engineering Co., Ltd.; W. H. Dorman and Co., Ltd.; R. A. Lister & Co., Ltd.; A. Lyon & Wrench, Ltd.; Petters, Ltd.
Generators and dynamos.—Siemens Bros. Dynamo Works, Ltd.
Wire and copper-covered rope.—B.I. & Helsby Cables, Ltd.
Electric torches and parts.—British Ever-Ready Co., Ltd.; Efandem Co., Ltd.
Steel wire.—W. Bain & Co., Ltd.; R. Johnson & Nephew, Ltd.; Lancashire Wire Co., Ltd.; Longford Wire Co., Ltd.; Whitecross Co., Ltd.
Works services.—Electric light installation at Hilsea: Foot & Milne, Ltd. Electric light installation at Montrose: Edmundson's Electricity Corporation, Ltd. Extensions to electric lighting at Northolt: C. Cooper and Co.

INDIA OFFICE STORE DEPARTMENT.

Alternators.—Lancashire Dynamo Co., Ltd.
Engines.—Parsons Motor Co., Ltd.
Fans.—J. Stone & Co., Ltd.
Switches.—Siemens Bros. & Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering services.—Bramley electric lighting plant: Johnson and Phillips, Ltd.

POST OFFICE.

Telegraph apparatus.—Automatic Telephone Mfg. Co., Ltd.
Wood arms.—W. F. Holloway & Bros.; Rudder & Paynes, Ltd.
Telegraph cable.—W. T. Glover & Co., Ltd.; I.R., G.P. & Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Telegraph Construction and Maintenance Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Dry cells.—Siemens Bros. & Co., Ltd.
Clamps.—Walls, Ltd.
Instrument cords.—B.I. & Helsby Cables, Ltd.
Iron terminals.—Walls, Ltd.
Telephone mouthpieces.—North British Rubber Co., Ltd.
Cable distribution plugs.—B.I. & Helsby Cables, Ltd.
Stay-rods.—Bullers, Ltd.
Insulator spindles.—Bayliss, Jones & Bayliss, Ltd.; Bullers, Ltd.; F. W. Cotterill, Ltd.; Guest, Keen & Nettlefold, Ltd.
Telephones.—Automatic Telephone Mfg. Co., Ltd.
Copper binding-wire.—B.I. & Helsby Cables, Ltd.
Copper strand wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.

London.—POPLAR.—The B.C. has accepted a tender at £745 for a Bessemer petrol wagon for the Electricity Department.

Swansea.—T.C. Electrical pumping plant for the Waterworks Committee, £681: Messrs. Mather & Platt.

FORTHCOMING EVENTS.

Institution of Civil Engineers.—Tuesday, March 27th. At 5.30 p.m. At Great George Street, S.W. Lecture on "The Decimal System of Coinage, Weights and Measures," by Mr. Harry Allcock.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, March 28th. At 7 p.m. At the University, Edmund Street. Paper on "Machine Switching Telephone Gear," by Mr. F. R. McBerty.

Royal Institution of Great Britain.—Thursday, March 29th. At 3 p.m. At Albemarle Street, Piccadilly. Lecture (II) on "Modern Improvements in Telegraphy and Telephony: Telephony," by Prof. J. A. Fleming, F.R.S.

Greenock Electrical Society.—Thursday, March 29th. At 7.45 p.m. At 22, West Stewart Street. General meeting.

Association of Mining Electrical Engineers (Lancashire, Cheshire and North Staffs. Branch.—Joint meeting with the Colliery Managers' Association. Saturday, March 31st. At 3 p.m. At the Technical College, Stoke. Paper on "The Electrification of a Group of Collieries," by Mr. H. Green.

NOTES.

Easter Holidays.—We shall be glad if our correspondents and advertisers will take note that the ELECTRICAL REVIEW for April 6th will appear on the morning of April 4th. All matter for inclusion in that issue must therefore reach us much earlier than usual. An announcement respecting the closing times for advertisements appears in our advertisement pages to-day.

Government Measures to Assist Trade.—The decision of the Government to increase the number of His Majesty's Trade Commissioners from four to 16 is most welcome. It is one of those measures that ought to have been adopted many years ago. We have argued for it for a long time, ever since we first saw the possibility of usefulness proved by existing officials in the same class—not without hope latterly, we confess. One Trade Commissioner for the vast Canadian territories! Four for the entire British Empire! Now we are to have 16, and the industries of the Empire should feel the benefit in a very short space of time. We trust that the appointment of the new Commissioners will not be delayed—we believe that Sir Albert Stanley will see that they are not—for we need to do everything in reason to be ready to assist trade development throughout the whole of our Dominions for their and our own industrial benefit immediately the situation improves. In announcing the above important step at the meeting of the Association of Chambers of Commerce, on Tuesday, Sir Albert also made other equally acceptable statements. He repeated what we have now become accustomed to from most lips of authority—namely, that the key industries must be secured to the country. Further, that there must be improvements introduced respecting the generation of electricity (doubtless he had in mind the appointment of his Departmental Committee); that our transportation facilities must be reformed; and that a big financial institution could render great assistance in connection with the industrial extensions of the future. It appears, in the last-named connection, that a scheme has been completed, which the Government will support and encourage, to establish a British Trade Corporation to facilitate and establish large credit banks for the purpose of developing British trade. That Corporation would receive a charter; it would not unduly interfere with the operations of existing banking institutions, but would do work which could not very well be done by them. Its Board would consist of representatives of industry and commerce, and associated with it would be experts from various industries who had a very wide knowledge of the world and its affairs. Attached to the Corporation would be an Information Bureau and Intelligence Department.

Legal.—MUNITIONS COURT CASE.—Before the Tees and Darlington Munitions Tribunal, at Stockton-on-Tees, last week, four electricians were charged with having refused to work a reasonable amount of overtime. Fines of 10s. were imposed. One of the defendants observed that "the man who is prosecuting can come in at 8 o'clock and leave at 5." He added that he worked 79 hours one week. The Chairman: But the next week you put in 63 hours. Defendant: Yes, I had a right to; I was five days in bed over the job. The Chairman said the Tribunal were pleased to see that the defendants had been working well lately, their time-sheets being the best they had seen for a considerable time.

BRITISH THOMSON-HOUSTON CO., LTD., *v.* DURAM, LTD.—Judgment was given on Tuesday dismissing the plaintiffs' appeal in this patent action, the Court confirming the decision of Mr. Justice Astbury as to want of subject-matter.

Training for the Air Services.—With a view to affording to young men below the age of 18 a preliminary training for the Air Services, the Aeronautical Institute has decided to establish a course of instruction covering a working knowledge of aviation motors, and of the function and construction of the various parts of the aeroplane concerned with its sustentation, propulsion, and evolution both in flight and on the ground. The course will last about three months, and will entail a full-day attendance five days a week. It will be independent of any other organisation, whether Governmental or not, and will not be a guarantee that any of its students will be granted commissions in the Air Services. Full particulars can be obtained from the Hon. Secretary of the Aeronautical Institute, 3, Arlington Street, London, S.W. 1.

Electrical Excavating Data.—Electrically operated excavators are being used on a large drainage scheme in Idaho, U.S.A. Energy is obtained at a pressure of 44,000 volts from an

overhead line; the average power consumed is 0·88 KW.-hour per cubic yard of material excavated, varying with the material excavated, being as low as 0·39 KW.-hour in light sandy loam, including all line and transformer losses.—*Canadian Engineer.*

The J.I.E. and Engineering Students.—The Council of the Junior Institution of Engineers, on January 25th, passed a resolution having reference to extending the advantages of membership to apprentices at approved works and students of such technical schools and colleges as may be approved by the Council from time to time. Such students would be admitted at a reduced subscription, be permitted to attend all meetings and visits, and, by means of the existing J.I.E. "Engineers' Register," would be assisted in obtaining employment in engineering works when their course of technical study had been sufficiently advanced.

A Committee has been appointed to prepare the preliminary details of such a scheme for further consideration.

The activities of the Institution—by Juniors for Juniors—are already well appreciated, and the spirit of comradeship existing in its ranks has become proverbial throughout the engineering profession. No other Institution even in its "Student" or "Graduate" Section offers quite the same advantages to its members. Informal discussions upon engineering subjects take place every Friday evening, from October to May inclusive. Papers presented by specialists are read and discussed monthly in London, Manchester, Sheffield, and Birmingham; and each month, even under the present unfavourable conditions, a visit is paid to works containing features of engineering interest. In this way students at recognised engineering schools and colleges and apprentices in engineering works may obtain a grip of the essentials of their future work which study alone can never give.

Before proceeding to consider and discuss the matter the Committee is anxious to obtain, more particularly from principals and professors of technical schools and from works managers, promises of support and comment. Communications are therefore invited, in order that the Committee may be guided by the experience of others to whom the project is of interest either directly or indirectly.

Electric Furnaces for Treating Steel.—Speaking in the discussion on the heat treatment of steel at the Institution of Mechanical Engineers, on Friday last, Sir Robert Hadfield, F.R.S., said that even the very best gas-fired or coal-fired furnaces did not enable steel makers to get the uniform temperatures that were absolutely necessary for them. Steel was a most delicate material, far more delicate than most people imagined, and he hoped that before long we should have some form of electrically-heated furnace for the purpose. There was no doubt whatever that with an electrically-heated furnace it was possible to get more uniform control over variations in temperature, and he believed that the electric furnace was coming. Considerable attention was being given to this matter in America, and he hoped we should not be behind in this country. One direction in which this end might be the more easily attained was in the production of cheaper electric power. He hoped to live to see the day when we should have large furnaces—not laboratory furnaces—heated electrically, because in that way it would be possible to get a more uniform quality of steel, simply because the crystals of the steel could be controlled in a better manner.

Foreign Trade.—The February Figures.—The official returns of imports and exports during last month contain the following electrical and mechanical figures:—

	February, 1917.	*Inc. or dec.*	12 *months*, 1917. *Inc. or dec.*
IMPORTS.			
Electrical goods, &c. ...	107,340	+ 10,846	+ 67,998
Machinery	509,725	− 103,966	− 87,158
EXPORTS.			
Electrical goods, &c. ...	270,940	− 27,698	+ 63,453
Machinery	1,808,324	+ 283,671	+ 791,801

L.C.C. Committees.—The L.C.C. is recommended to confirm the appointment of the following Committees for 1917-18:—

Highways Committee.—Sir John Benn, D. Davies, W. H. P. Gibson, G. M. Gillett, A. O. Goodrich, F. C. Harrison, W. Haydon, D. Hazel, G. H. Hume, W. Hunt, J. Little, H. Marks, W. A. Nicholls, A. H. Scott, H. Ward, A. W. Yeo.

Stores and Contracts Committee.—W. H. Ecroyd, W. C. Johnson, Miss A. S. Lawrence, H. Marks, H. Parsons, I. Salmon, H. R. Taylor; the Asylums, Education, Fire Brigade, Highways, Main Drainage, and Parks Committees have each to elect a representative.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Monday, March 26th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, March 28th.—Instructional Class, 8.15. Platoon Drill, Platoon No. 2

Thursday, March 29th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30. Signalling class.

Friday, March 30th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Recruits' Drill, 6.30—8.30.

Saturday, March 31st.—Commandant's parade, 2.45. Uniform for drill in Hyde Park.

Sunday, April 1st.—Special work at Bombing School. Parade Clapham Common Station (City & S.L. Tube Ry.), 9.45 a.m.

(By order), Macleod Yearsley, *Captain and Adjutant.*

Educational Facilities for British Prisoners of War.—At a Conference of Examining Bodies in Great Britain, held last week at the Board of Education under the presidency of Mr. A. T. Davies, C.B., chairman of the British Prisoners of War Book Scheme (Educational), it was unanimously decided to approve certain proposals for the encouragement and recognition of the studies pursued by prisoners during their internment. Various examining bodies (including most of the Universities) have already intimated their willingness to recognise work done and examinations passed in camps, and to extend to the men, on their return, facilities for sitting for examinations under conditions which will take account both of their special circumstances and their needs. It is intended that the decision arrived at shall be communicated, as soon as possible, to the various internment camps in enemy and neutral countries. In the meantime, it is suggested that friends of student prisoners when writing to them, should draw their attention to the steps in this connection which are being taken on their behalf.

B. of T. Departmental Committee on Electric Supply.—The President of the Board of Trade having intimated to the L.C.C. that he proposes to appoint a Departmental Committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their proper development, and having expressed a desire that Mr. G. H. Hume should represent the Council on the Committee, it has been agreed to nominate Mr. Hume, on the understanding that the Council is in no way committed as to its policy in the matter.

Linking-up Electricity Works.—A conference was held last month at the Ealing Town Hall, when the chair was taken by Ald. Peal, chairman of the Ealing Electricity Committee, who explained the reasons actuating the Ealing Borough Council in moving in the matter of bulk supply. After considerable discussion, it was elicited that the Ealing Borough Council was in favour of laying down, on co-operative lines, a large bulk supply power house on the bank of the river, of such capacity as would enable it to deal with the non-peak supplies for the whole of the western area. The Council would accept responsibility for a share of the capital required. The chairman of the Barnes U.D.C. expressed the opinion that his Council would be prepared to confer further on the above lines. It was suggested that the Ealing representatives should ask all the neighbouring authorities to meet at Hammersmith to consider the proposals, with the view of instructing the engineer to prepare a draft scheme.

The Metric System.—At a meeting of Newcastle-upon-Tyne Local Section of the Institution of Electrical Engineers on March 12th, the chairman (Mr. H. W. Clothier) said it would be remembered that at their last meeting Mr. Maccall raised the question of the metric system in connection with engineering standards and specifications, and, after discussion, proposed that a recommendation from the Section be sent to the British Engineering Standards Committee that they should draw up their specifications with a view to the possible future adoption of the metric system. At that Section's Committee meeting, which had just been held, the following resolution had been passed—"That this Local Section being of the opinion that the use of the metric system may be made compulsory in a few years, request the Council to approach the British Engineering Standards Committee with a view of the latter preparing modified specifications in readiness for this change, and that wherever convenient new standards be made in even metric measurements." The suggestion was formally approved.

At the annual meeting of John Wright & Eagle Range, Ltd., last week, the chairman (Mr. H. J. Yates) said the need of the metric system in this country was never so clamant as now. Instead of waiting for dilatory legislation, let every merchant and manufacturer in the country make an immediate start by having all dimensions and weights in his next catalogues expressed in the decimal system as well as in the present method. This would gradually familiarise people with the new system. It was also essential that catalogues should be in the customer's own language, and that prices should include delivery in his own country.

At the meeting of the Association of Chambers of Commerce of the United Kingdom on Wednesday, the Executive Council's Bills for decimalising our coinage and weights and measures were approved, and it was recommended that the Government should address inquiries to the Governments of Russia and the United States with a view to bringing about the adoption of the metric system in all the civilised countries of the world.

Bavarian Canal Scheme.—The Bavarian Diet has adopted a Bill for the construction of a canal from the Main to the Danube. The canal will begin at Aschaffenburg and end at Passau (near the Austro-German frontier). Bavarians expect the canal to be of the greatest importance in the future.

The Engineers' Club.—On Tuesday night, at Manchester, Mr. J. Drummond Paton opened a debate on "German Banking." The annual general meeting takes place at the Club on Tuesday next, at 6 p.m. The annual club dinner follows at 7 p.m.; a presentation will then be made to Mr. Edmund L. Hill, the late honorary secretary.

Light Alloys for Aircraft.—The Advisory Committee for Aeronautics has appointed a Light Alloys Sub-Committee to advise Government Departments on questions relating to light alloys, to institute research for the development and improvement of such alloys, and the methods of working them, and to assist in the removal of difficulties which may arise in their production and use

Institution and Lecture Notes.—Engineering Standards Committee.—The chairman of the Committee, Sir John Wolfe Barry, K.C.B., F.R.S., has accepted the invitation of the Council of the Institution of Civil Engineers to give the "James Forrest" Lecture on Wednesday, May 2nd, at 5.30 p.m. As the initiator of the organised movement of standardisation in this country, the lecturer has very appropriately taken as his subject "The Standardisation of Engineering Materials and its Influence on the Trade and Prosperity of the Country."

The growth of the principle of standardisation has been due in great measure to the steady work of the Engineering Standards Committee during the past 16 years, covering, as it does, most of the branches of engineering practice. The lecturer intends to draw particular attention to the new and important step taken by the Committee, which has for its object the furthering of British trade abroad through the wider dissemination in the British Dominions and in foreign countries of the British Standard Specifications translated into French, Spanish and Russian. No doubt the dimensions and weights involved will be expressed in terms of the metric system.; to use the English units would obviously be futile.

Mention will also be made of the local Standards Committees which are being formed in some 12 countries abroad; and, lastly, of the fact that, when the necessary arrangements can be completed, British Standard Specifications will be available to the public, both in their English and foreign editions, at a flat rate of 1s. each, or its equivalent in foreign moneys.

In connection with this new development we are informed that the appeal which the Committee has lately issued to the engineering industry of the country has, so far, resulted in the receipt of contributions amounting to over £12,000 from the leading technical institutions, trade associations, and manufacturing firms, and that H.M. Treasury has quite recently intimated the intention to ask Parliament to grant the Committee a sum of £10,000 for this special purpose. There can be no doubt as to the benefits which are bound to accrue to British trade and to the country at large through the widening of the scope of the Committee's activities now proposed, and we confidently expect that all those who are interested in the development of the export trade of the country will co-operate with the Committee in every way, and thus ensure the complete success of this important movement.

Institution of Electrical Engineers.—At the monthly meeting of the Scottish Local Section at Edinburgh on Tuesday last, Mr. G. A. Juhlin read his paper on "Voltage Regulation of Rotary Converters."

Association of Mining Electrical Engineers.—At a meeting of the West of Scotland Branch, in Glasgow, Mr. Matthew Baird, jun. (Hamilton), read a paper on "The Installation, Care, and Maintenance of Electrical Plant," and Mr. A. F. Stevenson (Glasgow) introduced a discussion on "Cable Protection Devices."

Books for Naval Engineers.—Any readers who have no further use for their text-books on dynamo design and construction, and will kindly lend these to engineers in the Royal Navy, will greatly help them to spend many a long hour usefully. The books will be returned in good condition. They should be sent, in the first instance, to the Electrical Review.

The Siemens Shares.—From an advertisement that appears in this issue, it will be seen that the Public Trustee has extended the time for sending in tenders for the shares in Siemens Bros. & Co., Ltd., from April 2nd to June 14th.

Gas Fatality.—An inquest was held at Leeds, on Monday, on John William Naylor (33), electrical engineer, and his wife, Ida Naylor (29), 39, Bristol Road, Leeds, who were found dead in bed on Friday. Death was due to coal gas poisoning. Verdict, "Accidental death."

Scientific and Industrial Research.—In the Civil Service Estimates relating to Education, Science and Art for the year ending March 31st, 1918, published on Monday, provision is made for a Grant in Aid of scientific and industrial research of £1,000,000. This will be paid to the account of the Imperial Trust for the encouragement of scientific and industrial research. The expenditure of the Trust will be audited by the Comptroller and Auditor-General, but any balance remaining on the account will not be surrendered at the close of the financial year. Grants will be made by the directions of a Committee of the Privy Council over an agreed period to approved trade associations for research, to supplement the funds of the associations, and payments in respect of such grants will not be liable to surrender by the grantees at the end of the financial year.—*Morning Post.*

Refillable Fuses.—Referring to the article in our issue of March 9th (page 261) on this subject, we pointed out that the report of the Bureau of Standards contained no illustration of the type of fuse chiefly concerned—that of the Economy Fuse and Manufacturing Co., of Chicago. Mr. D. A. Dawson, of Belfast Electricity

Works, has kindly pointed out that the fuse is illustrated in American advertisement pages, and we are thus enabled to reproduce the accompanying figure from the *Electrical World*, which clearly shows the construction of the fuse.

Fire.—Hazelbeach Hall, near Northampton, was recently destroyed by fire, due, it is reported, to an electric iron which was left by a servant with the current on. The iron had been in use between 1 and 2 p.m., and the fire was discovered about 8.30 p.m., and, owing to the distance—13 miles—to be traversed by the fire brigade, the building was gutted before the fire was got under control. It is a great pity that large country houses are not equipped throughout with electric fire alarms, and that electric irons are not always provided with thermal cut-outs.

Electric Stabiliser.—Mr. Orville Wright has invented a new type of electric stabiliser for aeroplanes, which consists of a pendulum swinging in a liquid bath and controlling the supply of current to a small propeller placed just above the pilot's head.—*The Car.*

Appointments Vacant.—Meter-tester for the Borough of Salford Electricity Department; electrical engineer (£1,200 to £1,500) for the L.C.C. Tramways Department; the L.C.C. is also inviting applications for the posts of operation superintendent and development superintendent. See our advertisement pages to-day.

Electrical Artificers.—The Admiralty has established a new Continuous Service Rating of Electrical Artificer 5th Class, with the relative rating of leading seamen, and pay at the rate of 3s. a day. The decision is announced in the *London Gazette* for March 16th.

Electricity Supply in India.—Commenting on the growing importance of public electricity supply, and the efficient conditions of management obtaining in company-owned undertakings, *Indian Engineering* points out that with municipally-controlled concerns the case is different, especially in India, as the decisions of the managing committee in both engineering and economic questions are largely governed by political considerations. Our contemporary, therefore, suggests that every municipal electricity supply undertaking should have at least one expert on the committee of management, nominated by the Government, and that all such undertakings should be obliged to run on the principle of a dividend-paying concern.

Inquiries.—Makers of arc welding plant and of the Kenrick electric iron are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Bexhill-on-Sea Electric Light Committee has appointed Mr. R. C. Carter as assistant engineer at £150 a year.

On Saturday last officials and workmen of the Blaenavon Co., Ltd., presented a gold watch to Mr. Rowland Jones, manager of the electric plant, on the occasion of his departure for Sheffield; Mrs. Jones was presented with a gold bangle.

The General Purposes Committee of the Stoke Newington B.C. has recommended that the salary of Mr. H. Large, chief assistant in the electric lighting department, be increased to £180 per annum, and that he receive an honorarium of £25 for his services as acting borough electrical engineer. Small increases were recommended to other members of the electricity staff. It was further recommended that consideration of the salaries of Mr. S. Hann, borough electrical engineer, Mr. E. G. McKenzie, sub-station assistant, Mr. S. Bone, and Mr. F. Rayner, who are serving with H.M. Forces, be deferred until their return.

In succession to Mr. Arch. Page, who has been appointed assistant general manager of the Clyde Valley Electrical Power Co., the Glasgow T.C. Electricity Committee has appointed Mr. R. B. Mitchell, superintendent of street mains, as assistant electrical engineer, at £600 per annum, rising by annual increments of £50 to £800 per annum. Mr. G. L. Black, district mains superintendent, was appointed mains superintendent at £300, rising to £500.

General.—The *Times* states that Sir William Crookes, O.M., F.R.S., has been elected a Foreign Member of the Swedish Royal Academy of Science.

On 10th inst., at Stretford, Mr. W. Reginald Chilton, of the works power department, British Westinghouse Electric and Manufacturing Co., Ltd., was married to Miss Blanche May Molyneux, of Manchester. The bridegroom was the recipient of a handsome case of cutlery, presented by his colleagues.

Mr. C. Hamilton Wickes, H.M. Trade Commissioner for Canada, who is now in this country, is, as on previous occasions, interviewing in London, at the Offices of the Department of Commercial Intelligence, representatives of firms who make appointments with him. Immediately after Easter he will visit trade and industrial centres in the provinces for the same purpose. Firms in the electrical and engineering industries who desire to have the benefit of his advice, and the information at his disposal, concerning British trade with Canada, should communicate with the Controller-General of the above Department, at 73, Basinghall Street, E.C.

Mr. James Bastian, who for many years represented the Bastian Meter Co., Ltd., and the Dussek Bitumen Co.

throughout the United Kingdom, and has latterly held the position of sales manager for the Bastian Electric Co., Ltd., has accepted an appointment under the Ministry of Munitions.

Roll of Honour.—Second-Lieutenant Cyril D. McCourt, whose death while leading as bombing officer in France is announced, was 34 years of age. He gained an Institute Scholarship at the City and Guilds of London Central Technical College, and, after gaining his diploma in chemistry, he served for a brief period as private assistant to Prof. H. E. Armstrong, F.R.S. In 1903 he was appointed chief chemist to the Morgan Crucible Co., Ltd., which post he resigned six years later in order to collaborate with Prof. W. A. Bone, F.R.S. (then of the University of Leeds), on the industrial applications of the new principle of incandescent surface combustion, which collaboration speedily resulted in the many important inventions comprised under the "Bonecourt" system of surface combustion. In pursuance of this work, Mr. McCourt became successively managing director of Radiant Heating, Ltd., and chemist and technical adviser of the Bonecourt Surface Combustion Co., Ltd., and, later on, also of the Commercial Laboratories, Ltd. He was subsequently appointed consulting chemist to the Morgan Crucible Co., Ltd., which position he held up to the date of his death. He carried out numerous researches on ore concentration, on refractory materials, on the applications of surface combustion, and on problems of furnace construction.

Rifleman A. Wood, who has been killed in action, was formerly employed in the meter department of Messrs. Ferranti, Ltd., Hollinwood.

Private Reg. Ormerod, Seaforth Highlanders, has been wounded in Mesopotamia, and is now in hospital. He was on the staff of the British Westinghouse Co., Ltd., Trafford Park.

A Military Medal for gallant service whilst in France with an anti-aircraft battery, has been awarded to Driver Bass, of the Dover Corporation tramway staff.

Sergeant Wm. Boden, East Lancs. Regiment, who had since 1907 been on the Burnley Corporation electricity staff, has died at Plymouth from pneumonia. He had only just recovered from shrapnel wounds.

Corporal E. Jackson, formerly with Mr. R. F. Winder, electrical engineer, of Leeds, has been mentioned by his commanding officer for the second time for distinguished conduct in the field.

Private J. H. Dowson, Machine Gun Corps, who was electrician at Thornley Colliery (Co. Durham), has died from wounds received in Macedonia.

Private James Smith (23), East Lancashire Regiment, reported killed in action, was employed as clerk to Mr. Cowell, tramways manager, Blackburn.

Private S. Mugg, of Durham, who was formerly an electrician with Messrs. Laidler, has died whilst on military service.

Private John Marriott, R.A.M.C., who was employed with Messrs. J. W. & R. Graham, electricians, Huddersfield, has just been awarded the Military Medal for gallantry and devotion to duty on the battlefield.

Obituary.—Mr. C. K. Hamilton.—We regret to record the death, which occurred on March 15th, of Mr. C. K. Hamilton, who was a member of the staff of Messrs. W. T. Glover & Co., Ltd., for some 15 years. For the greater part of that period he represented the firm in the South of England. Mr. Hamilton had been in failing health for the past two or three years.

NEW COMPANIES REGISTERED.

India-Rubber Manufacturers' Association, Ltd. (146,506).—Private company. This company was registered on March 15th, as a company limited by guarantee, with not more than 100 members, each liable to £1 in the event of winding up, to protect the interest of india-rubber manufacturers in the United Kingdom, to collect status information, &c. Annual subscription, £10. The first members of the committee of management are:—J. T. Goudie, Leyland & Birmingham Rubber Co., Ltd., Leyland, near Preston; P. Bate, Castle Rubber Co., Ltd., Warrington; P. A. Birley, Chas. Mackintosh & Co., Ltd., Cambridge Street, Manchester; J. H. C. Brooking, St. Helens Cable & Rubber Co., Ltd., Warrington; R. Eccles, F. Reddeway and Co., Ltd., Pendleton, Manchester; J. Henderson, Ancoats Vale Rubber Co., Ltd., Ancoats, Manchester; D. Moseley, David Moseley & Sons, Ltd., Ardwick, Manchester; J. Tinto, Irwell & Eastern Rubber Co., Salford, Manchester; F. Webster, Avon India-Rubber Co., Ltd., 39, King Street West, Manchester. Registered office: 16, Deansgate, Manchester.

E. Reader & Sons, Ltd. (146,472).—Private company. This company was registered on March 14th, with a capital of £20,000 in £1 shares, to take over the leasehold Phœnix Works, Nottingham, and to carry on the business of engineers, founders, smiths, boilermakers, electrical engineers, &c. The subscribers (each with one share) are:—A Ogilvie, 108, Brampton Road, St. Albans, engineer; S. H. Pearce, 23, Kellett Road, Brixton, S.W., engineer; H. W. Spencer, 1, Longton Avenue, Sydenham, S.E., engineer; M. F. Stevens, 2, Rookfield Close, Cranmore Way, N. 10, engineer; A. A. Mackintosh, 24, Loraine Road, N., engineer. The first directors are to be appointed by the subscribers. Solicitors: Mills & Morley, 38, Lincoln's Inn Fields, W.C.

Sentinel Co., Ltd. (146,485).—Private company. This company was registered on March 14th, with a capital of £5,000 in 496 pref. shares of £10 each and 800 ord. shares of 10s. each, to carry on the business of electricians, electrical, mechanical, motor, telephone, heating, ventilating, and general engineers, manufacturers of scientific, time recorders, signals, surgical, nautical, optical, and other instruments, &c. The subscribers (each with one share) are:—J. F. J. Malone, 86, Rothbury Terrace, Newcastle-on-Tyne; H. L. Riseley, Westfield House, Gosforth, engineer; F. E. Hannay, 61, Osborne Road, Newcastle-on-Tyne, solicitor; E. Hannay, 5, Beach Road, South Shields, solicitor. The first directors are J. F. J. Malone, H. L. Riseley, F. E. Hannay, and E. Hannay. Solicitors: F. E. Hannay, North-Eastern Bank Chambers, South Shields.

National Time Recorder Co., Ltd. (146,424).—Private company. This company was registered on March 12th, with a capital of £10,000 in £1 shares, to carry on the business of manufacturers of time-recording machines and clocks, electrical engineers, &c. The subscribers (each with one pref. share) are:—G. W. Lowe, Rosenau, St. Peter's Road, St. Margarets-on-Thames, sales manager; A. T. Brown, 65, Monega Road, Forest Gate, E., engineer. The first directors are A. C. Krause (chairman and permanent governing director), F. W. Lowe, S. B. Causer, and A. T. Brown. Solicitor: N. G. Driver, 20, Warwick Court, Gray's Inn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Central Electric Supply Co., Ltd. (53,080).—Capital, £100,000 in £5 shares. Return dated February 27th, 1917. All shares taken up; £100,000 paid. Mortgages and charges: £500,000.

Alpha Electrical Co., Ltd. (138,040).—Capital, £2,000 in £1 shares. Return dated December 31st, 1916. Three shares taken up; nothing called up. Mortgages and charges: Nil.

Alliance Electrical Stores, Ltd. (111,884).—Capital, £25,000 in 47,500 pref. ord. shares of 10s. each and 1,250 def. ord. shares of £1 each. Return dated February 16th, 1917. All shares taken up; 10s. per share called up on seven pref. ord.; £3 10s. paid; £24,996 10s. considered as paid on 47,433 pref. ord. and 1,250 def. ord. Mortgages and charges: Nil.

Vaughan Engineering Works, Ltd.—Second mortgage debenture for £2,500, dated March 8th, 1917, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Morris & Whitham, Ltd.

David Bridge & Co., Ltd. (106,016).—Capital, £25,000 in 16,000 pref. and 9,000 ord. shares of £1 each. Return dated February 5th, 1917. 15,830 pref. and 4,170 ord. shares taken up; £20,000 considered as paid. Mortgages and charges: £8,800, secured by debenture trust deed. Also charge on land to guarantee a perpetual yearly rent charge of £54 until buildings erected on other land.

British Electrical Export Co., Ltd. (138,028).—Capital, £2,000 in £1 shares. Return dated March 10th, 1916 (filed January 9th, 1917). 103 shares taken up; £103 paid. Mortgages and charges: Nil.

Bogota Telephone Co., Ltd. (69,059).—Capital, £45,000 in 20,000 pref. and 25,000 def. shares of £1 each. Return dated November 3rd, 1916. 18,200 pref. and 18,607 ord. shares taken up; £27,807 paid on 9,200 pref. and 18,607 ord.; £9,000 considered as paid on 9,000 pref. Mortgages and charges: Nil.

Robert W. Blackwell & Co., Ltd. (63,446).—Capital, £50,000 in £1 shares (reduced from £250,000 in May, 1916). Return dated January 13th, 1917. All shares taken up; £18,338 paid; £31,662 considered as paid. Mortgages and charges: Nil.

Bullers, Ltd. (62,020).—Capital, £400,000 in £10 shares (20,000 pref.). Return dated December 27th, 1916. 15,000 ord. and 15,000 pref. shares taken up; £150,070 paid on 7 ord. and 15,000 pref.; £143,930 considered as paid on 14,993 ord. Mortgages and charges: Nil.

British Battery Co., Ltd. (137,965).—Capital, £1,000 in £1 shares (800 pref.). Return dated January 2nd, 1917. 800 pref. and 199 ord. shares taken up; £999 paid. Mortgages and charges: £1,000.

Burmah Electric Tramways & Lighting Co., Ltd. (75,090).—Capital, £200,000 in £5 shares (20,000 pref.). Return dated January 4th, 1917. All shares taken up. £100,000 paid on the pref.; £100,000 considered as paid on the ord. Mortgages and charges: Nil.

London Electron Works Co., Ltd.—A. Taylor, of Thames House, Queen Street Place, E.C., ceased to act as receiver or manager on February 19th, 1917.

CITY NOTES.

The Alby United and Nitrogen Products Companies.

The annual meetings of the Alby United Carbide Factories, Ltd., and of the Nitrogen Products & Carbide Co., Ltd., in which it holds a quarter interest, were held in London last week, Mr. A. E. Barton presiding. Speaking at the Alby United meeting, the chairman said that the Odda Works were producing at the rate of nearly 90,000 tons of carbide per annum, and the demand was so insistent that they were quite unable to cope with it. Of that quantity, 57,000 tons was delivered under a pre-war contract for conversion into cyanamide. The demand for carbide for lighting had been maintained, while the demand for industrial purposes, such as oxy-acetylene welding and cutting, &c., had exceeded all anticipations, and there was every indication that this would prove permanent, and would increase very considerably under normal conditions. The North-Western Cyanamide Co. paid 15 per cent., as against 10 per cent. for 1915; the Alby United Co. now held a controlling holding in that company. Nitrogen Products & Carbide Co. had reached the profit-earning stage. The Alby United Co. was erecting at Newcastle an electrode factory. They consumed a very large quantity of electrodes (about 4,000 tons a year), and this was a matter which had given the directors a great deal of anxiety. Prior to the war they were purchased in Germany and Austria, but since the war commenced they had been purchasing them in America. Shipping, however, was not an easy matter in these times, and they therefore decided some few months ago to build works in England. They were starting with a capacity of 5,000 tons, which was afterwards to be increased, and this would mean a saving when these electrode works were completed about six months hence, of about £15,000 a year to this company. There was no doubt that the factory would be considerably enlarged in the very near future, because he firmly believed that after the war there would be in England a very big production of steel by electric processes. It was going ahead very rapidly now, and he thought it would consume very large quantities of electrodes, so that he had every hope that this would be quite

a profitable branch of their business, in addition to giving them a supply to meet their own requirements.

At the meeting of the Nitrogen Products Co., Mr. Barton said that the Swedish factory had worked continuously during the year producing both carbide and cyanamide, which were meeting with a ready sale in that country at satisfactory prices. The English factory for the production of nitric acid and nitrate of ammonia by their catalytic process had commenced working, but it would not attain its full output for some weeks. This was the first plant of the description to be erected in great Britain, and as the greater part of it was entirely new in design it spoke volumes for the ability and resource of British manufacturers that they had been able to undertake such work under very difficult conditions. The plant erected by their licensees in France has been running for some months; further factories were being put up there, and an installation was well under way in Italy. This company, with the large water power at its disposal, would be in a unique position to assist not only this country, but the whole world, by the production on a large scale of a cheap nitrogenous fertiliser. The harnessing up of the Aura water power was being proceeded with. They expected to be able to make a substantial further distribution for the year ending June, 1917. He was convinced that within the next ten years the whole of the company's 1,000,000 H.P. would be used in the direction of nitrolin for both chemical and fertilising processes.

London Electric Supply Corpn., Ltd.

Mr. R. H. Benson presided at the annual meeting held in February. The report for 1916 then adopted showed that the profit was £55,214, against £77,688 for 1915. After paying debenture interest and sinking fund charges, and 4 per cent. on the preference shares, £7,068 remained to be carried forward. The number of units sold was 49,810,105, as against 50,757,584. Total costs per unit sold .80d., as against .64d., owing to coal and wages costs. Average receipt per unit sold (lighting and power) 1.02d., as against .96d. for 1915. Expenses of generation increased 73 per cent. compared with 1914 owing to the war, viz., from £67,693 to £127,897, while the units sold increased by 7 per cent. An accident to the generating station during the year caused considerable damage and a temporary stoppage of the supply. Mr. Benson said that the year had been a bad one for everybody whose profit depended mainly on cost of coal and wages. To their great regret, in spite of all efforts to economise in generation and to increase the price charged, the net result was 4 per cent. paid on the preference shares instead of 6 per cent., and nothing on the ordinary shares. Coal had cost 10s. per ton more than in 1915. The situation of the generating station on the river at Deptford, which enabled them to use the cheapest coal, sea-borne, and the best for their purpose, was not so economical now that they had to rely on rail-borne coal plus the cost of lighterage and handling, beside a varying, and not always satisfactory, quality. The riverside position of their station, which in normal times was their greatest source of strength, was, owing to the war, their weakness, though only temporarily, and they hoped it would not last much longer. Later, the speaker referred to the general question of power supply. He said that two remedies were possible for the much-harassed enterprise of producing electrical power in the London district; one was amalgamation or "association," as the Act of 1908 called it, combining plants so as to reach the utmost economy in generation (as yet no company had seen its way to amalgamate under that Act); the other was to profit by the example of our American cousins, abolishing fixed rates and taxes as a charge, or clog, on industry and production, and to substitute a share of the profits to the municipal authority instead. The initiative for a better state of things here could not come from within the companies, but must come from above. Necessity was the mother of invention, and though it might be temporarily impossible to obtain an increased price for power commensurate with the increased cost of generation, still, the tendency was for the price as well as the quantity of units sold to increase. Whenever the cost of coal began to go down again, and good seaborne coal was obtainable instead of irregular supplies of indifferent coal, involving the expense of selecting and sorting, their prospects would rapidly change. Mr. R. S. Bain, the managing director, said that during the year 2,419 H.P. of motors had been connected for industrial supply purposes, making the total at the end of the year 18,102 H.P., while 800 H.P. had been received since. While the receipts increased by over £8,000, the expenditure increased by nearly £31,000, coal being responsible for over £20,000. Steamers becoming almost unobtainable and freights six times the pre-war rate, they had to get rail-borne coal, and the nearest docks for such were at Poplar, which meant trans-shipment across the river, a costly and difficult proceeding.

Metropolitan Electric Supply Co., Ltd.

Mr. A. W. Tait presided at the annual meeting on March 13th. He said that the gross revenue increased by £48,708, or 21 per cent. The units sold increased by 4,750,388 (or 24 per cent.) to 24,595,118. The gross revenue was the largest since they lost the Marylebone area, but they were living in exceptional times, and a large part of the increase was for power for important purposes, particularly in the Western area, and part was attributable to the increased charges for supply to cover part of the great increase in cost of generation. They believed that with proper development the Western area would continue to show an increasing revenue. A large amount of revenue had been lost owing to the lighting restrictions, but they hoped that with the improved offensive and defensive measures now available against air attacks, the restrictions would be gradually relaxed, and that some of the revenue would be regained during the current year. There was also a certain loss of revenue due to the Summer Time Act, which Act looked like becoming permanent. In the expenses, the only item that showed any serious advance was coal, and this they would naturally expect in consequence of the larger output. There was an increase of 25 per cent. on the average price paid per ton in 1915, and they must expect further substantial advance this year while abnormal conditions prevailed. At present they held a reasonable stock, and were well covered for future supplies. There were also increases in costs of materials, labour, and insurance. The amount put to depreciation and reserve was £40,000, as compared with £27,000 in the previous year. They had written £4,047 off stores account, as they had consolidated and cleaned up certain of the stores, and had reorganised the sales department in the London area. A certain amount of old stock had been got rid of, and some further charge in this respect would occur in the present year, though the amount would not be considerable. Certain revisions and alterations were being made in the system of administration which would lead to greater efficiency and economy, but this process must necessarily be gradual, so that there would be no interruption in the proper development and operation of the business. They had at present fairly large capital commitments in connection with the installation of a further 4,000-KW. turbine and new boilers at Willesden station, which would increase economy in generation and enable them efficiently to supply the increasing demand, particularly in the Western area. Further plant was also being installed at Acton and Ironbridge for the same reason, and additional mains were being laid. Including the £40,000 added now, the depreciation and reserve fund stood at £377,358. The amount appropriated had not been arrived at by any process of taking certain percentages on the various items of capital expenditure, based upon the assumption of their probable life, but it had been considered a reasonable provision for a company whose assets were of such magnitude, to set aside for the purposes of depreciation and reserve. He hoped that they would be able to regard this amount as a minimum contribution to that account, and he would be pleased if they were able as time went on to increase it substantially. Mr. Harrison Cripps, when presiding in March, 1915, dealt fully with the schemes then under consideration for the consolidation of the electric supply undertakings of London, and he expressed the belief that a proper combination of the present companies would reduce costs and would ultimately be of advantage to the consumer. He could only reiterate that belief on behalf of the new members of the board, and hope that when the proper time arrived for the negotiations to be taken up again the subject would be approached with a broad give-and-take spirit by all the London supply companies and by the L.C.C. The board as reorganised had only been in harness since October last, but certain progress had been made and economies effected. So far there had been no difference of opinion as to the proper policy to be pursued with regard to the development of the company's areas and the general operation of the business. All the members of the board had one object in view—the efficient development of their areas, and particularly that in the west. The chairman paid a tribute to the work of the staff during a difficult time, especially the general manager, Captain Rendell. They had recently appointed Mr. Markby to the post of chief engineer, and they felt confident that he would be an able successor to Mr. Highfield, with whom he had been associated for many years in the company's service. Mr. Markby had been seriously ill, but he was recovering. Mr. Highfield's continued connection with the company as consulting engineer would be of the greatest possible value. Mr. Cunliffe Owen, the secretary, had also rendered good service, doing everything possible to assist the reorganisation of staff which was now taking place.

Bruce Peebles and Co., Ltd.

Mr. F. E. Andrews presided at the annual meeting, at Edinburgh, on March 16th. After referring to the nature of the work of the year, he said that in order to cope with the increased business, and to expedite and improve the output, they had, as opportunity offered, continued the rearrangement of the works with marked results as regards efficiency, but owing to the abnormal times the management of such a manufacturing concern had been one of continual difficulty; materials and labour, fuel and transport, all had been a source of anxiety, without mentioning the ever-varying prices. The turnover was larger than in any similar period of their existence, the volume of orders obtained was greater, and the value of work sent out from the shops was also appreciably greater. They had always given careful and special attention to export trade to the Colonies and other countries, as they had always attached very great importance to this part of the business. They had been very anxious that, if possible, none of this trade, which had been so assiduously fostered by them, and on cultivating which they had spent appreciable sums of money, should pass into the hands of foreign competitors. He was glad to say that up to

the present they had been able to keep closely in touch with all their customers abroad, and had managed to retain a certain portion of their business with them, though, naturally, nowadays the acceptance and execution of orders for export presented considerable difficulties, and were always subject to the permission of the Ministry of Munitions. It was, therefore, all the more gratifying that in spite of all obstacles, and under the onerous conditions prevailing at the present time, they had been able to do so well in that direction. With reference to the company in which they, in conjunction with several other electrical manufacturing firms, were interested for dealing with business in Russia, offices had been opened there under a well-known engineer, the company was getting steadily to work, and they anticipated that after the conclusion of hostilities it would be of considerable use to them, and fully justify their expectations by helping them to obtain a reasonable share of the trade in electrical plant in that country. They had taken advantage of present circumstances in order to push their machinery in a neutral country where previously they had done little or no work; they had already obtained several good orders, and he had every hope that later on this nucleus would enable them to build up a quite satisfactory business there. After briefly alluding to the company's war relief fund, Mr. Andrews dealt with the accounts. The gross profit from manufacturing and trading amounted to £24,469, compared with £13,945 in 1915, and £11,649 in 1914. The total gross profit for 1916 was £26,249, as compared with £14,916 for 1915. They had a balance of £11,930 to be carried to the credit of profit and loss account, but this was subject to the Excess Profits Duty and Munitions Levy for 1915 and 1916, the amounts of which it had not yet been possible to finally determine. These taxes were obviously a considerable burden, and this company was very hard hit by them, for they were based on the average profits of the years immediately preceding the war. During those years the electrical manufacturing industry was emerging from a long period of depression, and in their own particular case they were just making good headway after a time of misfortune. However, money had to be raised for prosecuting the war, and they therefore must bear cheerfully that portion of the financial burden which fell upon their shoulders. The question of goodwill had already been discussed on previous occasions, and would be carefully considered and duly dealt with when the opportunity offered. After much uphill work, the balance sheet had been gradually and steadily put into a fairly healthy condition. Last year he told them that the question of a reorganisation of the capital account would have to be dealt with at the proper moment. That time had now arrived, and the matter had been receiving the careful attention and consideration of the directors. A scheme was being formulated which the board considered fair and just to the holders of the different classes of securities. The future held many problems for all, but especially for engineering works such as theirs—problems of export trade and of output, of organisation and of labour—all of which they would face and overcome in the way engineers always overcame every difficult problem presented to them. They looked forward to the future of the company with every confidence.

Oxford Electric Co., Ltd.

Sir Henry Mance presided at the recent annual meeting. In his financial memorandum, read by the secretary, it was stated that the cost of fuel had been £600 more than in 1915, though the units generated had decreased by 6 per cent. In the cost of coal the increase of the year was 20 per cent.; compared with the pre-war period the increase in cost was nearly 40 per cent. The gross profit was less than for 1915 by £1,500, and the decrease in the amount available for distribution was £1,600. Sir Henry said that compared with the results obtained by other provincial electric lighting companies who, like themselves, depended mainly upon lighting load, they might congratulate themselves that the reduction on the ordinary shares was not more serious. The colleges were practically all closed, and the lodging-houses most of them empty; the Daylight Saving Bill had probably caused a loss of £1,000, and restricted lighting affected their revenue very appreciably. The demand for power, heating, and cooking helped them to some extent, and the hospitals made up for the loss of one or two colleges. They had incurred no capital expenditure, and had practised economy wherever possible. The prohibitive price of copper and the difficulty in obtaining cable compelled them to adopt a conservative policy in regard to the extension of mains, except for military purposes. They had made a modest increase in the price of current. In regard to the future, they would have to wait until the end of the war before they could expect to see any considerable increase in their business.

Automatic Telephone Manufacturing Co., Ltd.

Profit for 1916, after estimating Excess Profits Duty and contingencies, £56,450, plus £6,774 brought forward. Directors' fees require £2,450; depreciation on patents, goodwill, buildings, plant and machinery, £10,000; written off underwriting commission on shares, £4,000; written off preliminary expenses, £2,000; dividend on preference shares, £12,000; dividend of 5 per cent. (less tax) on the ordinary shares, £18,000; carry forward, £14,774. No orders have been taken for new Post Office public exchanges, the Department having necessarily to curtail work of this description. The exchanges at Portsmouth, Paisley, and Blackburn were, however, completed and put into use during the year, and continued to give satisfaction. Several smaller exchanges for works have also been completed, and one for a public institution. Meeting: Liverpool, March 26th.

British Insulated and Helsby Cables, Ltd.

The profit for 1916, after making provision for estimated liability for Excess Profits Duties to date, was £300,466, plus £160,096 brought forward = £460,562. This total is dealt with as follows: Directors' and debenture trustees' fees and remuneration to Works' Committee, £5,915; interest on first debenture stock, £22,500; interest on second debenture stock, £10,000; dividend on preference shares, £30,000; depreciation on buildings, plant, machinery, &c., £25,000; special depreciation on plant and machinery, £20,000; transfer to reserve account, £70,000; transfer to special reserve account, £8,500; transfer to first mortgage debenture stock redemption account, £5,000; 15 per cent. dividend and 5 per cent. bonus on the ordinary shares, £100,000; carrying forward, after making provision for estimated liability for Excess Profits Duties, £163,647. The business has been well maintained during the year. Meeting: Liverpool, March 26th.

Windermere & District Electricity Supply Co., Ltd.—Receipts from sales of current during 1916 fell off by £544. Charges for lighting current were increased by 10 per cent. in July last. The Diesel oil plant has been in use during nearly the whole year, and has worked well, and as the result of a favourable contract for fuel oil made towards the end of 1915 there has been a considerable reduction in expenses. Keswick Electric Light Co. has again had smaller sales of current, and has only been able to pay 2 per cent. on account of arrears of interest on its debentures. The present high price of fuel may cause a considerable increase in expenses this year, and the directors do not expect to be able to declare an interim dividend on the preference shares in October. The revenue balance was £1,656, plus £148 interest on Keswick debentures. 2 per cent. is to be paid on the preference shares, and £63 is to be carried forward.

Edison Swan Electric Co., Ltd.—Mr. C. J. Ford explained at meetings of different classes of shareholders, on 14th inst., that the company must have more working capital available in order to take advantage of opportunities for increased trading, and the scheme of arrangement submitted was prepared with that as its main object. He explained the details of the scheme, and said that though the concessions made to the debenture-holders for giving up their right to £200,000 of security would place upon the company an additional charge for interest and sinking fund of £6,468, that was far more than compensated for by the benefit that would accrue from the additional working capital secured.

Prospectus.—*Shropshire and Worcestershire and Staffordshire Electric Power Co.*—With the consent of the Treasury, this company is offering for subscription an issue of 50,000 7 per cent. redeemable cumulative preference shares of £1 each at par. The plant installed at the end of 1916 was 20,325 kw., and a further set of 8,000 kw. will be in service in the course of a few weeks. The gross revenue for 1915 was £75,936, for 1916 £158,000 (approx.), and the estimate for the current year is £210,000. The list closes on March 27th.

Gateshead & District Tramways Co.—The revenue for 1916 was £77,333, and after deducting expenses, including renewals £3,000, the balance is £35,136, plus £4,239 brought forward. There is put to special reserve £7,500, to reserve £5,500, to sinking fund for redemption of mortgages £2,540, 6 per cent. pref. dividend £757, 5 per cent. pref. dividend £6,000. After paying a dividend of 12s. per share, and a bonus of 8s. per share on the ordinary shares, £3,579 is to be carried forward. The special reserve stands at £17,500, and to this £6,239 there has been charged Excess Profits Duty for 1914 and 1915.

British Aluminium Co., Ltd.—The directors recommend placing £60,000 to depreciation and £75,000 to reserve. Final dividend at the rate of 12 per cent. per annum on the ordinary share capital, making 10 per cent. for the year. £26,926 is to be carried forward.

Hadfields, Ltd.—The directors propose to add £85,000 to the reserve and renewals account, and to carry forward £185,695. In addition to the interim dividend of 1s. per share paid in July on the ordinary shares, a further dividend of 4s. per share (making the rate the same as last year) is to be paid, together with a bonus of 1s. per share, all free of tax.

Canadian General Electric Co., Ltd.—Quarterly dividend, 2 per cent. to March 31st on the common stock, and a half-yearly dividend of 3½ per cent. on the preference stock.

Browett, Lindley & Co., Ltd.—According to the "Financial Times," this company is recommending a dividend on the ordinary shares for the first time since 1900. The rate is to be 4 per cent. In June last 50,000 ordinary shares were written down from 20s. to 15s.

Manila Electric Railroad & Lighting Corporation.—Dividend, 1½ per cent. ($1.50 per share) for the quarter on the common capital stock.

Waste Heat and Gas Electricity Generating Stations, Ltd.—The annual meeting was held in Newcastle-upon-Tyne on March 14th. Mr. F. S. Newall, presiding, said that the amount of waste gas, heat, and steam which they had received during the year had, under the exceptional circumstances, been well maintained. It had been slightly less at some parts, and rather more at others. By becoming the intermediary between coal owners and iron masters, the power companies, who were the authorised distributors of electrical power in their respective areas, had been able to utilise the whole waste heat and gas in the most efficient way possible by converting it into electrical power. The power thus generated in the company's stations had been invaluable to the power companies, and through them to the manufacturers in the districts, and particularly when the price of coal had been so high.

Veritys, Ltd.—According to the "Financial Times," 7 per cent. per annum (7s. per share) is to be paid on the preferred ordinary shares for half-year, making 7 per cent. for year; £1,517 forward. Last year, 6 per cent. for the year, £1,084 forward.

Isle of Wight Electric Light & Power Co., Ltd.—After paying the preference dividend and putting £2,000 to renewal fund account, £338 is to be carried forward.

Doulton & Co., Ltd.—A dividend of 5 per cent., less income-tax, is announced on the preference shares for 1915.

Simplex Conduits, Ltd.—Dividend 10 per cent., and bonus 10 per cent., both free of tax, for 1916.

Mirrlees Watson Co., Ltd.—Dividend for 1916, 10 per cent., less tax, putting £17,500 to general reserve and carrying forward £6,960.

British Electric Transformer Co., Ltd.—Dividend on ordinary shares for 1916, 7½ per cent. per annum, carrying forward £5,781.

STOCKS AND SHARES.

Tuesday Evening.

The very excellent character of the news from the Western Front provided great encouragement not only to the man with money to invest, but also to him who is already the holder of shares and who has been a little doubtful as to whether he ought to sell or to hold. In the latter case, the news of the capture of Bapaume and Peronne had the direct result of causing a fair number of previous selling orders to be cancelled; and the Stock Exchange complaint is now that there is very little stock about to supply the felt want. Undoubtedly, when the market in the new War Loan stocks opens, there will be a warm welcome for it; and unless conditions change rapidly the stock, we venture to predict, will command a premium from the outset.

Electric lighting shares are firm, with the rest of the investment departments. The approach of Summer Time carries no terrors with it this year. City of London ordinary are 10s. better. Counties recovered their dividend, and so did Westminsters. There is a scarcity of floating supply; and although buyers are not paying what they deem fancy prices, they are open to temptation at current quotations. The trouble, however, is to get shares.

The difficulties of the supply companies were well put the other day at the meeting of the Bournemouth & Poole Electric Co., but the chairman pointed out that the falling-off in the amount of lighting was compensated to a large extent by increased sales for heating and national work. The tone of the market is good throughout, but business remains quiet.

Home Railway stocks further benefited by the strength of Consols. The premier security—Consols occupying that position until the War Loan dealings start—has crossed 54, demand coming largely from holders who have had their American securities commandeered by the Treasury. The money thus released has overflowed into other investment departments, including that for Home Rails; and during the past few days a feature has been the buying of low-price stocks, from which it would appear that the spirit of speculation is by no means dead, even amongst Home Railways.

The Undergrounds are slow to recover from the depressing effect induced by the speech of Lord George Hamilton at the meeting of the Underground Electric Co. However, Metropolitans are better, though there remains a dullish tendency in the income bonds of the holding concern. Quite a feature is the advance of most of the debenture and preference stocks, these putting on several points in most cases during the past week, while still the buyers lament that they have to go unsatisfied.

This week's dividend record embraces the declaration of 15s. per share on British Insulated & Helsby Cable shares, including the bonus. The profit for the year came to £300,000, and £163,600 was carried forward, being £3,600 more than was brought into the accounts. The Henley's Telegraph Works board recommend a final dividend on the ordinary shares of 10 per cent., making 15 per cent. for the year (not 13 per cent., as given in our "City Notes" last week), together with a bonus of 10s. per share. The Western Telegraph Co. has declared the usual quarterly dividend of 3s. per share, free of tax; and the Automatic Telephone Co. is going to pay 5 per cent. on the ordinary shares for the year. British Westinghouse repeats the previous performance of 7½ per cent. on the preference shares.

Save in the last-named, no particular changes have resulted from these declarations, but the market for all good industrials is a strong one. British Westinghouse preference rose 3/16 to 50s. on the hope of an increased dividend next time. The rise in Edison Swan debenture stocks which we mentioned last week has been fully maintained. Castner-Kellners are 1/16 lower.

Mexican industrials are harder, and British Columbia stocks attracted buyers because of an unexpectedly good dividend declaration by the Grand Trunk Railway of Canada, which helped to spread optimism far beyond its own immediate circle. Rio Tramways bonds are again higher. Brazilian Tractions are depressed, and show a fall of 1½ on the week. In the home group, North Metropolitan debenture is 2 points down at 87.

Telegraph stocks and shares are quiet. Marconis keep steady at 2⅞. Globe preference gave way a little.

The rubber market is by far the most active in the Stock Exchange, and buying has been resumed on a large scale, principally by the provinces. With the price of the material showing a slight improvement and dividend declarations being very satisfactory, a bout of speculative activity is once more a feature, the only fly in the ointment being the possibility of an increase in the Excess Profits Duty in the forthcoming Budget. People who declare that speculation is impossible under the present Treasury regulations evidently do not know their rubber share market. Baser metal shares have benefited by a rise in the price of tin, but there is very little going on amongst the copper issues.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Mar. 20, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅝	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	3 1/16	—	7 1 2
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11¼	+ ⅛	6 19 2
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
County of London	7	7	10½xd	+6/9	6 16 7
do. 6 per cent. Pref.	6	6	9⅜xd	+ ⅛	6 6 4
Kensington Ordinary	9	7	5¼xd	—	5 11 7
London Electric	4	3	1	—	Nil
do. do. 6 per cent. Pref.	6	6	3⅜	—	5 6 8
Metropolitan	8½	8	2 7/16xd	—	6 9 9
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	10	8	6¼xd	+ ⅛	6 10 8
South London	5	5	2⅝	—	6 19 0
South Metropolitan Pref.	7	7	21/-xd	—	6 13 4
Westminster Ordinary	9	7	5⅝xd	+ 3/16	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	9¼	—	6 7 8
do. Def.	30/-	33/6	22	—	6 16
Chile Telephone	8	8	6 1/16	—	6 15 3
Cuba Sub. Ord.	5	5	7½	— ⅛	6 13 4
Eastern Extension	7	8	13⅜	—	*5 16 4
Eastern Tel. Ord.	7	8	19⅞	—	*5 16 10
Globe Tel. and T. Ord.	6	7	11½	—	*5 19 2
do. Pref.	6	6	9⅜	— ⅛	6 4 8
Great Northern Tel.	22	22	34½	—	6 7 5
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	2⅞	—	3 9 2
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2½	—	4 14 1
United R. Plate Tel.	8	8	6 3/16	+ 1/16	*6 2 0
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅜	—	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1½	1	24	+1	4 3 4
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	6	80	— ½	*6 5 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 1/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅝	—	9 12 4
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	45½	—1½	8 15 10
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	63	+2	8 1 4
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	39½	+2	Nil
do. do. Deb.	4½	4½	62½xd	—	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	+1½	Nil
do. 6 per cent. Bonds	—	Nil	25	+2½	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds	Nil	Nil	27⅝	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	22	—	5 9 1
British Aluminium Ord.	5	7	28	+6d.	5 7 2
British Insulated Ord.	15	17½	122	—	6 17 3
British Westinghouse Pref.	7½	7½	24	+ ⅜	6 0 0
Callenders	15	20	12½	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	34 1/16	— 1/16	6 18 0
Edison & Swan, £3 paid	Nil	—	3/16	—	Nil
do. do. fully paid	Nil	—	1/16	—	Nil
do. do. 4 per cent. Deb.	4	4	60	—	6 1 3
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15	—	8 6 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11½	—	*8 10 2
Telegraph Con.	20	20	30	—1	*6 13 4

* Dividends paid free of income-tax.

SOME THOUGHTS ON THE CAPITAL AND LABOUR PROBLEM.

By W. T. WARDALE, A.M.Inst.E.E.

In discussing the problem of obtaining greater mutual respect and helpfulness between Capital and Labour, most people are content to generalise by saying that Capital must cease to regard wages as something to be relentlessly cut down, and labour simply as a rather awkward money-making device; whilst, on the other hand, Labour must cease to regard the enhanced output as a sure ground for the "sack" the month after next.

Wonder is expressed that the two bodies cannot see the very simple sense of the two facts quoted above, and there the matter is left; if the matter was so simple, it would have been settled long ago.

As a rule, the workman will not look at the commercial side of the trade which employs him, and, generally, he so thoroughly despises the business of selling that he can hardly be brought to believe that many articles take more time and money to sell than to make. Now, if the workman would only attempt to understand the selling, or commercial, side of the trade, he would have taken a most important step towards understanding the peculiar handicaps often encountered by the employer in endeavouring to find profit for himself, and work and wages for his men.

This brings us to another point: the workman is often told that his employer does not find work for him, but that it is the customer who finds the work for him, the employer merely acting the part of a greedy middleman, who is quite unnecessary.

Like so many other freely-used phrases, this idea is theoretically correct only for a theoretically perfect state; it is not practically true under our present conditions, and even under idealistic and Utopian conditions the connection between maker and user could seldom be as direct as this idea suggests.

Take the case of a man opening a factory for electrical motors, and motor-starters, in a district possessing no such industry. This man struggles for custom in the open markets, and spends time, money, and energy in order to bring work to his factory; true, his aim in doing so is to fill his own pocket, but in pursuing this aim he is exercising a valuable function, and must, in order to carry it through, find work for his workmen.

Now, let this man invent a patent motor-starter which is more reliable, and costs, say, 30 per cent. less than any motor starter then on the market. As soon as this fact is known orders simply flow to his works, and, due to his brains, energy, and pluck, he finds work for a larger and larger number of workmen.

Thus, in the present conditions, the employer does find work for his workmen; and there are many cases of firms which, due to one cause or another, have found work for their men for many years, but never a dividend for the shareholders.

In the same way, all the great inventors, such as Marconi, find work for many thousands of people by creating new demands for new apparatus.

Thus, the successful solution of the commercial problem is of the utmost importance to the workman.

In this connection, the writer knows of a very interesting case of the refusal of the workmen to work to commercial conditions. The example has the additional merit of being in connection with a firm run by the workmen themselves.

Some years ago the men at a certain shear works quarrelled hopelessly with their employers, the upshot being that a works fitted with water power was taken, and a co-operative and co-partnership firm established.

Friendly buyers offered to find a market for the goods turned out, and there was the added advantage that the goods would not have to be designed, but simply made to designs supplied.

The outcome of the adventure, which still pursues a peripatetic way, was as follows:—The workers are in two bodies roughly speaking, forgers and grinders; obviously, if the forgers do not work the grinders have nothing to grind. The district in which the works are situated happens to be largely agricultural, whilst the workmen of the locality are enthusiastic gardeners. Living and rents in the country are cheap, whilst many of the men have one or two cottages, usually left to them by relatives. In consequence, these men find that an income of between 20s. and 30s. a week, in normal times, will allow them to live comfortably in the style in which they were brought up. Not being beholden to any capitalistic boss, they knock off when they have earned the amount which will last them for the next week, and devote the rest of the time to gardening and other pursuits of which they are fond. The writer knows for a fact that several times there has been risk of serious trouble, and of the works being shut up, because the grinders, who wish to make a full week, and to earn, say, 50s. or thereabouts each week, are hung up by the forgers refusing to work more than three or four days a week, the attitude being, "I've got enough for myself this week, and I'm not going to work any longer for anybody who wishes to make more." In peace times the concern finds that it only gets the dribblings which are left over from the market when other firms are full up. The factors and merchants cannot be humbugged by waiting on the pleasure of the gardening fraternity. Naturally, the more industrious men become irritated at this sort of thing, but, having a stake in the concern, cannot close the place down without some pecuniary loss to themselves.

If these same men, who will not work a full week, were to walk up to the local tobacco shop and be told by the proprietor, "Oh,. I'm not selling any more this week; I've made my week's living, I'm going fishing to-day and to-morrow; you can have some more tobacco on Saturday, when I come back," they would be positively enraged at the tobacconist treating them to their own medicine. "How," they would ask, "does he expect to keep his trade if he won't consider his customers?" They, however, tell the prospective buyer of shears that he must wait their good pleasure. They neglect the commercial proposition, and the result is that, in normal times, what could be a really well-filled busy works simply drags on earning no more than a pittance for anybody.

Thus, the neglect of the commercial factor must cease; instead, the workman must be brought to realise that wrapped up with this same factor is that of increased output, which will mean a full order book for his employer, and a full and regular wage-packet for himself. How is he to be brought to realise the truth of this fact, and what is the obstacle now standing in the way? The answer is: Suspicion.

Why, and how, has this suspicion arisen, and why is it so stubbornly maintained? And to what lengths does it lead the workman? It will be best, perhaps, to answer the last query first, by giving an example of the dire effects of this feeling, the example being well known in the quarter in which it happened.

Many years ago, a well-known firm of engine-builders, whose care for their men was well recognised, decided to give the men employed at their works a chance to save money at a rather more rapid rate than usual. To this end, they arranged to take what savings the men cared to leave with them week by week, allow 2½ per cent. interest from the firm, bank the whole with a well-known banking company, who were prepared to give another 2½ per cent. on the amounts, making the rate of interest 5 per cent. in all. Note that this money was not used in the business of the company, but was withdrawable at very short notice, or in small sums on demand. The object was simply to show the men what could be done by regular small savings of their own money, and to encourage thrift by a good rate of interest; this interest of 5 per cent., by the way, was given at a time when debenture stocks were issued at 3¼ per cent. to 4 per cent. at the outside.

For some time the deposits grew, and it almost seemed as if some real and lasting good was to be the outcome of the scheme. Then, without any warning, without any shadow of trouble looming on the horizon, the deposits were withdrawn first one by one, and then by larger and larger numbers of men, until in three months from the start of the unusual withdrawals there was not £10 standing to the credit of the scheme. It might be thought that rumour had set about the report that the firm were in low water; this was not so, and, incredible as it may seem, the sole reason for the emptying of the savings account was that some jaundiced and envious individual had gone round the works and told the men concerned the following tale: "Ah, it's all very well you thinking that it's being done for your benefit, but wait and see! All they want to find out is how much you are able to save, and to reckon up how much you have over what it costs to keep you. You see if, in a few months' time, they don't use the fact of so much having been saved to cut wages down. It's been done before, with similar tricks, at So-and-So's place (mentioning works where rate-cutting managers had been allowed full sway), and it will be done here as well." That tale, and that tale alone, told first to one, and then to another, with references to other works, settled the whole matter.

The heads of the firm satisfied themselves, after full inquiry, that the cause of the withdrawals was as stated above; small wonder that it effectually put an end to the philanthropic interest they felt in their men.

Most people would state that the above distrustful and suspicious attitude was simply and solely due to the unscrupulous rate-cutting indulged in in practically every engineering shop in the district at that period. The matter, however, goes further back than this, and is much more deeply rooted in the men's minds.

The writer has satisfied himself, as the result of long and careful inquiry extending over many years, that the root cause is the wrongs inflicted on the working population in the early days of the rise of the industrial system.

In particular, the manner in which children of extremely tender age were worked long hours under cruel supervision is largely to blame, not only for the bitterness felt by the workman toward his master, but also for the spirit of distrust shown even towards a well-meaning employer, and for the often short-sighted policy which the men adopt and are ready to follow.

The Lancashire or West Riding workmen of to-day have spoken with the men who, as children, went through the terrible times so well and strongly condemned by Prof. Sadler. It has not been a matter of reading or hearing of such things being done in far-off lands; the mischief was perpetrated on their own fathers and grandfathers, and perhaps, even worse still from a national point of view, on their mothers and grandmothers.

In consequence of this treatment, the workman of 70 years ago not only learnt to distrust the master, but, by the process he endured in the mills at a very early age, practically had his mental faculties blunted and stunted. The same thing happened to the women of that class and generation; in consequence, the children raised from such parents cannot be blamed if, in addition to a feeling of bitter opposition towards the employing class, they were born with a very stunted and short-sighted outlook on life.

The men had to have Trade Unions to get fair play; 40 years ago most unions had to fight for existence. Can it be wondered at that, now they have become strong, they should be used at times in a short-sighted and tyrannous manner? If one rears up three generations to learn as a basic fact that they can only secure a living wage and decent conditions by being ready to fight the employer, what else has one the right to expect than the present-day distrust and short-sighted policy of most of the union members?

Those members of the unions who have worked themselves into leading positions generally get the opportunity to study the economic side of the matter from a better and more all-round point of view than the ordinary union member can hope to have; and what is the consequence? Simply that as soon as these more enlightened views are put forward, the leader in question is dubbed a traitor, and his arrangements with the employers flouted and flung in his face. The evil has, of course, been aggravated and perpetuated by those managers who, often sprung from the men themselves, have taken a delight in cutting wages and prices, and, wherever possible, making of no avail the concessions obtained by the men from the employers. The workman of 50 years ago told his son to watch the employer, who would try to deceive him at all times and at every opportunity. He also solemnly warned him that if too much work was done in one month, or a machine capable of increasing the output was permitted to be used, then the next month or two would, as sure as the sun rose, see unemployment, and the permanent "sack" for many of the men. He also handed down the tradition that the commercial problem did not matter to the man.

The younger workman found out pretty quickly, owing to the machinations of the rate-cutting, nigger-driving manager, that the first portion of his father's advice had come literally true, and that he got nothing from the employer which he could not, through his union, force from him.

Can we wonder, then, that the other two traditional axioms of the workman, handed down by the same father who had warned him of the rate-cutting manager, have been accepted by him as essentially true? Thus, the matter of removing this unhappy feeling is no light one, as the cause is far deeper than is usually believed.

Only years of absolutely straight working will restore the faith in the employer, which is so necessary for securing the best results. The slightest sharp practice, or slim tactics on the part of any manager or foreman will at once arouse feelings which it has taken perhaps years to allay; and after the war these men must no longer be allowed the freedom they have enjoyed. They must be given to understand that any sharp tricks in connection with the men will be punished sharply and drastically.

The workman, on his side, must be ready to forget old-standing ideas and prejudices, and must, when he sees fair working, meet it with fair working in return. He may be assured that if he will not work with the employer, and will not consider and allow for commercial conditions, trade will decline, and employment at good wages become an impossibility. The evil done 80 years ago is not the fault of the employer of to-day; but he is often made to suffer for the things done in that far-off time. As a class, he has paid the full penalty for the mistakes of those early days, and this fact ought to be, and will have to be, recognised by the workman.

Let the employer who is irritated by the surly responses to his well-meant efforts bear in mind the cause of that surly attitude, and let him stretch his patience even a little more. Let the workman look to such places as Port Sunlight and Bournville, and remember that these happy industrial towns were founded, not by being forced out of the employers in question—that would never have been possible—but by the goodwill and good wishes of the employers towards the workpeople.

Let the workman take an interest in the commercial side of his trade; let him save up money collectively, not for the purposes of a strike fund, but for investment in the business at which he works. Such a policy pursued for 20 years would result in many more workmen being able to avoid seeking the shelter of the workhouse in their declining years.

The idea is not impossible; it only needs the difficulties on each side to be understood and appreciated in order to set on foot progress towards that desirable end.

The object of these notes has been to state those difficulties, in the hope that it may perhaps assist their solution.

HIGHER BOILER PRESSURES.

Our contemporary *Power*, in a recent issue, recorded the opinions of some well-known American engineers on the question of higher boiler pressures, amongst which were the following:—

Mr. F. Hodgkinson (Westinghouse Co.) considered that the only difficulty was the boiler (for pressures such as 600 lb. per sq. in.), and suggested some form of flash boiler. For the turbine it only meant the use of heavier parts for the extremely high pressure end at a small increase of cost, and in view of the theoretical gain of 10 or 12 per cent. it was important to secure it.

Mr. Samuel Insull (Chicago) thought there was quite a possibility of operating turbines and boilers at pressures as high as 1,000 lb., and regretted that the large-size turbine was being developed before the question of higher boiler pressures was settled.

Mr. R. J. S. Piggott (Remington Arms and Ammunition Co.), pointed out that the vacuum limit was practically reached, and as regarded higher pressure and superheat the characteristics of metals employed prohibited higher temperatures than about 700 deg. F. He did not much favour an exceedingly high pressure, say, 600 lb., with comparatively low superheat of 100 deg. F., for the reason that the most serious windage and friction loss occurred in the H.P. stages of the turbine; reducing the superheat would advance the dew point well into the H.P. stages. The first wheels of some of the 30,000 and 35,000-kw. turbine units had an efficiency of but 48 per cent., and although much of this apparent loss was recovered in later stages, the advancing of the dew point would increase losses due to wheel friction. Boiler plant might be designed for a normal temperature of 600 deg. F., but it was certain that this would increase at times to 700 deg. or 750 deg. F.

Mr. R. H. Rice (General Electric Co.) favoured all propositions tending to raise the limits of steam pressure and temperature, but pointed out that with high temperatures, considerable heat losses occurred at starting and stopping, and that such plant would be best used on 24-hour loads.

Mr. L. C. Loewenstein (General Electric Co.) said his company were prepared to handle temperatures up to 800 deg. F.

Mr. Frederick Sargent (Sargent & Lundy) said that both the General Electric Co. and Westinghouse Co. claimed that there would be no trouble about building a turbine for pressures of 500 or 600 lb., and temperatures of 700 to 750 deg. F. Several people, including Messrs. Babcock & Wilcox, were investigating types of boilers suitable for higher pressures, but preliminary designs along established lines were very costly. In the meantime, his firm decided to use the highest pressure suited to the present type, and the boilers at the Joliet (Ill.) station were designed for 350 lb. pressure and 225 deg. F. superheat. He further referred to the experimental plant of the B.T.H. Co. at Rugby (which was briefly described in our report on the I.M.E.A. proceedings in June last). Welded steam joints in pipe flanges and valves were now being used; the 35,000-kw. set at the North-West (Chicago) station was treated in this way—a thin weld being made inside the bolt circle, to seal the joint only, which was held together by bolts, as usual. High temperature could be obtained by low pressure and high superheat, but the economy would be greater if both the superheat and pressure were high; the present limit was given by the manufacturers of machinery. The raising of the average temperature would be an advance, and could be obtained by superheating the exhaust from the high-pressure end of the turbine before it entered the low-pressure end, which in conjunction with high initial temperature would give a high average temperature. When this was done, and provided present boiler, superheater, and economiser efficiencies could be maintained, a kw.-hour should be available at the switchboard per lb. of high-grade coal.

Prof. E. F. Miller (Mass. Institute of Technology) said he believed that many new plants would in the not distant future be designed for pressures approaching 600 lb., and he knew one plant which had been considering such pressures.

Dr. Ferranti wrote emphasising his belief in the necessity of much higher pressures and temperatures in order to secure the greater economies which modern conditions of power generation demanded.

Prof. W. D. Ennis (Brooklyn Polytechnic Institute) pointed out that thermodynamic considerations favoured high initial pressure rather than high superheat, as essential to efficiency; unfortunately, pressures had to be exceedingly high in order to get a temperature range even reasonably good. In modern plants steam temperatures of 550 deg. F. were common, which with saturated steam would involve a pressure of 1,062 lb. per sq. in., so that a compromise was necessary, and the highest practicable pressures with proportionately high superheats were employed. The frictional losses of a turbine were proportionate to the density of the steam, and high pressures increased the density, while superheating at any pressure decreased it. With fixed exhaust pressure, the expansion of dry steam led to greater liquefaction, as the initial pressure was greater. Particles of moisture due to liquefaction caused friction and wear, and superheat was the preventative. In European practice in the last five years steam temperatures up to 1,000 deg. F. had been, if not common, at least commercially feasible, particularly in the locomobile. Boilers with small water tubes would probably be

suitable with only minor modifications up to 350 or 400 lb., and on account of their reduced efficiency owing to the increased chimney temperatures, economisers might become standard equipment, as in Europe. As regarded engine pressures, he mentioned that Diesel engines regularly used 550 lb. compression, and many hot-bulb semi-Diesel engines with 300-lb. compression realised sudden maximum pressures of about 550 lb.

The Babcock & Wilcox Co., in the Prime Movers Committee report (N.E.L.A., 1916), mentioned that they had in course of construction a number of large boiler units for 350 lb. working pressure with 250 deg. F. superheat, following standard lines, but of heavier build. Inquiries regarding boilers of 500 to 600-lb. pressure with steam temperatures of 700 deg. F. had led to experiments which showed that such boilers could be manufactured as a standard commercial article if required. For 350-lb. pressure, the increased cost for large units over 200-225 lb. pressure would probably be about 20 per cent. The question appeared to be whether the advantages of the higher pressures with 700 deg. F. temperature limit would compensate for the difficulties, in comparison with 350 lb. working pressure and 700 deg. F. temperature. With such a temperature limit the problems to be solved were probably entirely outside the boiler and furnace.

An insurance view quoted was that any tendency greatly to increase the working pressure was likely to cause an increase in failures of such apparatus; the increased hazard resulting from explosions would also require to be met by a compensating increase in insurance rates.

THE VOLTAGE REGULATION OF ROTARY CONVERTERS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 306.)

Booster Control.—This method of voltage control is employed to a great extent for all classes of service. The voltage variation is obtained by the use of a synchronous booster mounted on the shaft of the converter. The type generally adopted is that with a revolving armature mounted between the converter slip-rings and armature. The field may of course be provided with shunt or series windings, or both, in accordance with the requirements of the service for which the converter is intended.

With the booster field unexcited and the converter operating on unity power factor, it is clear that the E.M.F. of the converter is not affected by the current passing through the booster, except to a very small extent, due to the impedance drop in the booster armature.

When the power factor varies from unity, the conditions are, however, quite different, as the booster armature reactance is then either magnetising or demagnetising, and the booster armature magnetomotive force must therefore be balanced by an equal number of ampere-turns on the booster field. The booster field may therefore require a certain amount of excitation, although no change in the converter E.M.F. is required. Conversely it is possible to obtain boost, positive or negative, without exciting the field of the booster, by producing wattless currents in the converter which will produce the excitation of the booster. This feature may be of service in cases of emergency, as when it is desired to put a converter into service and the bus-bar voltage has fallen below the lowest voltage obtainable from the converter under normal running.

From the above it is clear that the power factor is under complete control in a booster type of converter, as the influence of the wattless current on the E.M.F. can be counterbalanced by the excitation of the booster field. It should be noted, however, that it is essential not to operate a booster converter at a lagging power factor, as this will overload the booster field when raising the voltage, and may account for the booster not giving its full range in voltage.

The fact that the power factor can be kept at unity, or leading, if desired, is undoubtedly the chief reason why the booster type of converter has found such an extensive use. Some doubt may be expressed, however, as to whether this extensive use is altogether justified, as in many cases where comparatively small voltage variations are required, and the converter is not required to give wattless currents for power-factor improvement, the reactance control could be employed with equally good results.

In the simple converter all the electrical energy, except the small part absorbed in the losses, supplied on one side is transformed electrically and delivered in the form of electrical energy on the other side of the converter. The total armature reaction is in this case only produced by the losses in the converter, but the distribution over the pole-pitch is not uniform, with the result that a certain part is acting in the interpolar space. This must be compensated for by a certain number of ampere-turns on the interpole. The armature magnetomotive force is under these conditions a simple function of the load, and can therefore be taken care of by the ordinary commutating-pole winding excited by the load current.

When the booster is used, the effect of the converter armature is more complicated, due to the fact that a part of the electrical energy supplied to the converter is transformed into mechanical power and transmitted through the shaft to or from the booster, the direction depending on whether the boost is positive or negative. In the case of positive boost, *i.e.*, when the E.M.F. of the converter is increased, it acts partly as a motor supplying mechanical power to the booster, which then acts as a generator in raising the E.M.F. On the other hand, when the converter E.M.F. is reduced by means of the booster the converter acts partly as a generator receiving energy from the booster, which is then operating as a motor delivering its energy through the shaft to the converter. Under these conditions the effect of the armature on the interpoles is no longer dependent only on the load of the converter, but also on the E.M.F. of the booster. This is due to the fact that the alternating and continuous currents are not balanced, as in the simple converter, and the converter armature, therefore, develops a motor reaction when the boost is positive, and a generator reaction when the boost is negative.

The value of this armature magnetomotive force is directly proportional to the output of the booster. For example, with the booster excited so as to raise the converter E.M.F. 10 per cent. the armature reaction would increase the interpole ampere-turns by an amount equal to 10 per cent. of the alternating-current armature reaction, or, if the E.M.F. were reduced by the same amount, the interpole ampere-turns would be decreased by an amount equal to 10 per cent. of the alternating-current armature ampere-turns. This would, of course, mean an increase or a diminution of the flux required to obtain correct commutation; and when it is considered that as an average the interpole ampere-turns necessary to produce this flux, as well as compensate for the normal armature reaction at zero boost, only amount to about 35 per cent. of the armature ampere-turns, it will be readily appreciated that a reduction of 10 per cent. means a big change in the strength of the interpole flux. In order, therefore, to keep the interpoles at their correct strength at any load and voltage, it would be necessary to provide some means whereby the interpoles were automatically adjusted with the load. It is, of course, also necessary to vary the excitation on the interpoles with varying boost.

Unfortunately, it is not possible to compensate the armature reaction completely, as it is not constant for all positions of the armature, but fluctuates to a considerable extent. These fluctuations exist in the simple converter as well as in the booster type, but are accentuated in the latter under certain conditions of boost

Several different methods have been adopted in order to obtain the necessary compensation, all of which involve an auxiliary winding on the interpole, and in some cases special apparatus for varying the excitation of this winding. In most schemes, the variation in the excitation is obtained by variation of the resistance in the circuit of the auxiliary winding, and the accuracy of the compensation depends, therefore, on the number of steps in which the resistance is changed. The question of rapidity in adjusting the excitation is of importance in cases where sudden load fluctuations occur, and the time lag must, therefore, be reduced to the smallest possible amount.

The problem of accurate compensation of booster converters is, as will be appreciated from the above, not an easy one, especially in cases where large voltage variations are required.

A certain amount of boost can, of course, be obtained without any adjustment of the interpole excitation, but it is very limited, and as the conditions of commutation cannot be made uniform for all voltages, it is clear that full advantage cannot be taken of the material if good commutation is to be obtained at all loads and voltages. In other words, a given machine would reach its commutation limit at a lower load, if fitted with a booster for voltage regulation, than would be the case if arranged for reactance control.

When inverted running is required and voltage variation is necessary, a booster is essential, if the converter is not running in parallel with any other alternating-current plant, as reactance control cannot be used in such cases. This will be clear when it is considered that, with a given condition of load, to keep the speed, and therefore the frequency, constant it is essential to keep constant field current, assuming a fixed continuous voltage. In order to vary the E.M.F. delivered by the converter, it would be necessary, however, to vary the excitation, so that the two conditions are opposed. If the converter is running in parallel with an alternating-current system, it is possible to regulate the alternating voltage by means of reactance control, as in this case the speed of the converter cannot increase, due to the fact that it is held in synchronism with the system to which it is connected. Inverted running should, however, be considered as an emergency condition, as the rotary converter is primarily a machine for transforming alternating current into continuous current, and not *vice versa*.

The influence of the booster on the losses in the armature winding is of some importance and interest. The relations between the armature losses in a non-booster converter, and in a continuous-current generator with the same winding, have been established for different power factors, both for

the tap coils and for the whole winding. These ratios do not hold good, however, when a booster is introduced, as the resultant current in the armature winding varies for different values of boost. That this is the case will be clear when it is considered that the ratio of transformation of the converter is changed by the action of the booster. The values of the constants giving the ratios of the losses for different percentage of boost and power factor are shown in figs. 7 and 8, the former giving the ratios for the losses in the tap coil and the latter for the average losses of the whole winding.

The fact that the losses in the tap coils decrease with increasing negative boost is of practical importance in cases where full KW. output is required at the lower voltage, as the heating of the tap coils is the limiting feature as regards the copper loading of the armature, and higher current densities in the armature copper will be possible in cases where the voltage variation is obtained by means of a booster than would be the case if other means were used.

If the whole range were obtained by negative boost, a considerable reduction in the tap-coil losses would be obtained at the low voltage, but owing to the increase in the output of the booster, the cost of the converter would in most cases be increased.

The reduction in the losses obtained in ordinary cases is, however, of importance, especially in cases where the converter has to deal with wattless currents for power-factor correction.

Comparison.—No general statement as to which system of control is most advantageous can be made, as this must naturally depend on the conditions of the system on which the machines have to operate, but a study of a particular case may help to bring out the advantages and disadvantages of the respective types.

Assume that two ranges of voltage are required, *i.e.*, 400 to 440 volts for lighting and power, and 500 to 550 volts for traction, a fairly common case. For this voltage variation, the booster would required a range of ± 75 volts, which means that the output would be 15.8 per cent. of the converter output, on the assumption that the full range has to be obtained in a smooth curve, which is usually specified in such a case. Assuming a unit of 1,000-KW. output, the cost of the booster would be in the neighbourhood of 20 per cent. of the cost of the converter alone.

In the case of reactance control, the cost of the converter would be practically the same as for the booster control. Owing to the reactance and the tappings required in the transformer, the cost of this would be increased by approximately 5 per cent. of the converter cost. A three-pole double-throw switch would be required, the cost of which would be about 2 per cent. of the converter cost.

From the point of view of first cost, therefore, the advantage would be with the reactance control. The size of the booster would, of course, be materially reduced by arranging the transformers with tappings giving 420 and 525 volts respectively on the continuous-current side and providing a change-over switch as in the case of the reactance control. The advantage of this arrangement would be not only reduced cost, but also improved conditions from the point of view of commutation, on account of the reduced boost. This advantage is more marked in large units than in smaller ones, owing to the increased difficulties in commutation.

As regards the power factor, the booster type of converter has, as already stated, the advantage, as its power factor can be varied at will under all conditions of load and voltage, and, in cases where wattless currents are required for power-factor improvement independent of the voltage conditions, it is the only type suitable.

When no leading currents are desired, however, there appears little or no reason why the reactance type should not be used, as the power factor obtainable on the high-tension side is very close to unity over the whole range of voltage, and is slightly leading at the higher voltage, and it is doubtful whether better results would be obtained with the booster type, as very close adjustment is necessary to keep the power factor exactly at unity, and it should be remembered that it is necessary to adjust the field of the converter, as well as that of the booster, when changing the voltage of the converter, in order to keep the power factor at unity.

With the reactance type of control, it is only necessary to operate the field rheostat in changing the voltage, and the fact that the power factor is fixed definitely for each voltage is, therefore, not altogether a disadvantage, as less skill is required in operating this type of machine. Another point which should be considered is that if load having a power factor of approximately unity is added to a system having a low power factor, the conditions are of course improved in this respect, so that the converter acts as a power-factor improver without actually supplying leading current to the system.

In respect of commutation, the reactance control has the advantage, as good commutation is more easily obtained with this type. Satisfactory commutation can be obtained with the booster type of machine, but much finer adjustments as regards interpoles, brush-gear, &c., are necessary with this type of machine than with the former type if these results are to be obtained.

In many cases sacrifice is made in the most vital feature of the machine, *i.e.*, the commutation, in order to obtain the advantage of unity power factor, which may, or may not, be realised in actual operation.

The following summary of the two systems may be considered as generally applicable:—

	Reactance type.	Booster type.
Cost ...	... Cheaper.	—
Power factor	... Cannot be controlled at will for each voltage and load.	Can be controlled at will for any load and voltage.
Commutation	... Good commutation more readily obtained.	—
Range of voltage	... Limited (± 7½ per cent. may be considered as the limit).	Great range can be obtained (± 15 per cent. or more).
Efficiency ...	... Slightly higher.	—
Starting ...	... No difference.	No difference.
Space ...	... Less space required.	—
Maintenance	... —	More parts to keep in order.

The simplicity of the reactance control, coupled with its low cost and advantages in operation, are factors which recommend it very strongly wherever the range of voltages required permits its adoption, even at a sacrifice in the way of power factor.

We give below a corrected *résumé* of Mr. A. M. Taylor's remarks, which did not reach us in time for our report of the discussion last week:—

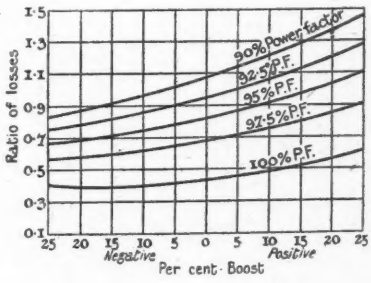


Fig. 7.—Curves showing Ratio of I^2R Losses in the Tap Coils of a Rotary Converter to those of a Continuous-current Generator with a Similar Winding.

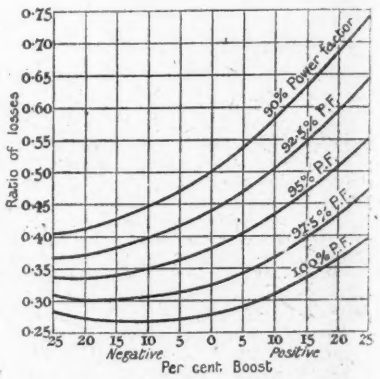


Fig. 8.—Curves showing Ratio of Average I^2R Losses in Armature Winding of a Rotary Converter to those of a Continuous-current Generator with a Similar Winding.

This paper appears to have for its object the showing up of the advantages of the reactance-controlled rotary, when used in the ordinary way; but a question that is exercising the minds of many station engineers is whether the rotary cannot be satisfactorily used "inverted" to a much greater degree than has, up to now, been done.

The use of batteries in A.C. sub-stations has enormously increased during the past few years, and there are many sub-stations, especially towards the outskirts of large systems, where a large A.C. load is transmitted through the sub-station to regions beyond and where, if it were possible to feed into the A.C. network from the sub-station battery, and at the same time to boost up not only the A.C. voltage *but also its power factor*, engineers would not hesitate to pay, perhaps, 25-30 per cent. more than they at present pay for rotaries, in view of the considerable saving in copper which would be effected in the mains, and of the, in some cases, really serious difficulty of being tied up, on the one hand, to D.C. mains fed from adjacent sub-stations of higher pressure, and, on the other hand, to its own A.C. mains which are considerably below the normal.

The speaker endeavoured to show, some years ago, that it was financially a safe proposition to put in batteries in the more distant sub-stations, even on the basis of unity power factor in the A.C. load; much more so would this be the case when the power factor was poor.

He believes that it is possible to obtain a large leading current from the rotary, both when it is delivering D.C. current to the sub-station bus-bars and also when it is running "inverted" off these bus-bars, *i.e.*, over the whole 24 hours, in fact, and this desirable result can, he believes, be obtained in either of two ways:—

1. A rotary with a large external reactance can be used

on the "charge," and the rotary designed to give the correct D.C. and A.C. volts when heavily over-excited (*i.e.*, with a large leading current); the reactance, in this case, acting to give a heavy positive boost from the A.C. mains to the D.C. mains. The same rotary, with the reactance cut out by a switch, and with the addition of an A.C. booster (or induction regulator) giving a large counter-boost, can again be run at a high excitation, and with a large leading current, this time "inverted," and feeding into the A.C. mains.

The vectorial conditions are shown in fig. A.

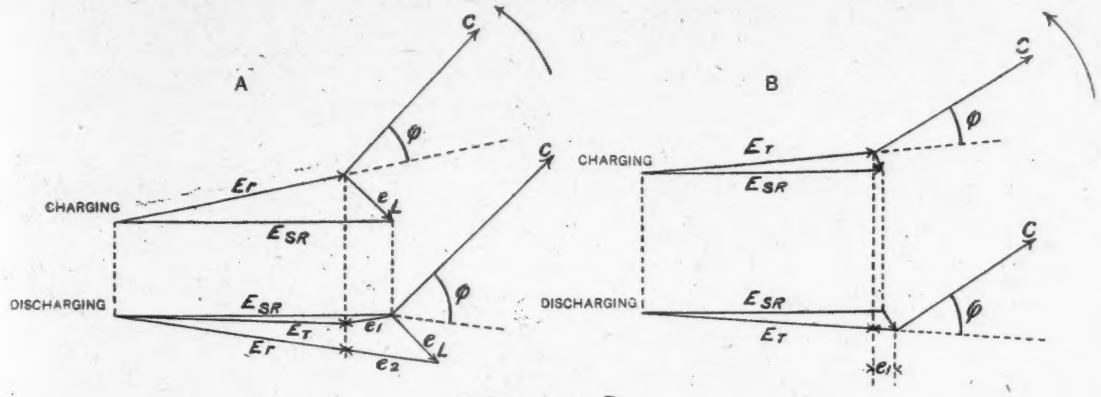
2. The alternative would be to have only the A.C. booster (*i.e.*, without the reactance), and to have the rotary and transformer with as little reactance in them as possible.

In this case the rotary would be run over-excited on the "charge" as well as on the "discharge" (*i.e.*, when running "inverted"), and would take a big leading current in *each* case. The booster would be used to give a counter-boost on the discharge only; or, if found more desirable, it might give a forward-boost on the "charge" and a counter-boost on the "discharge."

The vectorial conditions for the former case are shown in fig. B.

He (Mr. Taylor) would be much interested to know whether the sparking conditions would prevent such machines being built at reasonable cost. No doubt the booster would have to be bigger than is usually supplied; but he believes engineers would willingly face the cost for the sake of the improved power factor.

It is, of course, not necessary that the required boost should be furnished by a rotating booster. It could equally be provided by, for instance, the new type of static regulator described at the meeting by Mr. Juhlin, which also has the advantage that it could be added to any existing rotary.



FIGS. A AND B.

E_T = H.T. Mains; E_{SR} = Slip rings; e_1 = Counter boost, reactance out; e_2 = Counter-boost, reactance in; e_L = Reactance.

ELECTRICITY IN AGRICULTURE.

I.M.E.A. Agricultural Electrical Development Committee.

At a recent meeting of the Council of the Incorporated Municipal Electrical Association, the President, Mr. F. M. Long, referring to the paper read by Mr. Kerr at the last annual convention, suggested that the Council should take the initiative in developing this subject.

The Council, recognising the important part that electricity may be made to play in the better cultivation and greater production of the land, and in the extension of rural industries, have formed the nucleus of what is ultimately intended to be a committee representative of all interests with the object of a thorough investigation into the technical and commercial problems underlying the application of electrical energy for such purposes, by forming a small committee with powers to add to their numbers, both from the ranks of the Association and from other sources.

The Committee consists of Mr. S. E. Britton, city electrical engineer, Chester, chairman; Mr. F. M. Long, city electrical engineer, Norwich (President, I.M.E.A.); Mr. H. Faraday Proctor, city electrical engineer, Bristol; Mr. J. Christie, engineer and manager, electric supply department, Brighton; Mr. S. T. Allen, engineer and manager, electric supply department, Wolverhampton; and Mr. F. Ayton, engineer and manager, electric supply department, Ipswich.

Mr. W. T. Kerr, city electrical engineer, Hereford, has also been added to the Committee, and two sub-committees have been appointed to deal with publicity and technical matters, with Mr. Kerr and Mr. Long as chairmen, respectively.

The Committee will be known as "The Committee on the Development of Electricity in Agricultural Areas," formed by the Incorporated Municipal Electrical Association. The objects of the Committee will be:—

1. To investigate and advise upon the problems underlying the supply and use of electrical energy in agricultural areas for power, lighting, heating, culture, and other purposes for farms, villages, and rural industries.
2. To collect and collate information, and publish literature bearing upon the above.
3. To co-operate with agricultural and other associations.
4. To investigate in co-operation with manufacturers the development, manufacture, and adaptation of agricultural machinery, and appliances for utilising electrical energy.
5. To promote the exhibition of such machinery and appliances at agricultural shows and elsewhere.
6. To offer assistance in arranging demonstrations and lectures in conjunction with farmers' associations, clubs, &c.
7. To promote any legislation necessary to facilitate the application of electrical energy to agricultural areas.

When the Committee have formulated definite proposals for consideration and discussion, and compiled the necessary data and information, it is intended to invite kindred bodies to nominate representatives to serve on the Committee.

All communications should be addressed to the chairman, Mr. S. E. Britton, city electrical engineer, Chester.

Sir Oliver Lodge and Electroculture.—According to the *Birmingham Daily Gazette*, Sir Oliver Lodge, in a recent interview with reference to the forthcoming experiment in electroculture on some 50 acres of cereal and other field crops at Huntingdon Court Farm, near Hereford, said the scheme outlined was apparently what was desired rather than what had been settled; at any rate, the Agricultural Electric Discharge Co. had not, he thought, been consulted.

A large scale experiment on the electrification of crops, proceeded Sir Oliver, might with wisdom have been made by the Government many years ago, but they left it to private enterprise. The Agricultural Electric Discharge Co., of Gloucester, had gone into the matter in detail, and carried out the pioneering work without any State recognition and at a loss to themselves, but they had thereby gained some experience. They had supplied plants to the Board of Agriculture, and two had been working for Prof. Priestley, of Leeds, for a couple of years before the war. One had been supplied to the United States Agricultural Research Department. Another was working in Java, one in Norway, and six were supplied to Germany before the war. A few others had been erected in England and Scotland.

But all these must be regarded as experimental installations for the purpose of gaining experience as to which kind of discharge was most effective, and under what climatic conditions electricity was of most use, bearing in mind also that all agricultural experiments were necessarily slow because until the crops were reaped the results could not be scrutinised, and that conditions of failure, just as much as conditions of success, had to be examined, for both were instructive. Then, again, some seasons were very wet and some very dry. When there was plenty of sunshine it was possible that electrification was not much needed, and when there was a very wet season the crops might be inferior whether electrified or not.

Electroculture Experiment at Southport.—An interesting experiment in electroculture is to be made at Southport, where Mr. M. Ashley has been granted permission by the Food Supplies Committee to rent two 10-rod plots at Crowlands on which to carry out a scheme of electrical cultivation. The land adjoins the electricity works, and arrangements have been made for the supply of the necessary current. Messrs. M. Ashley, Ltd., electrical engineers, are manufacturing the plant, and undertaking the other expenses, and Mr. Black, the borough electrical engineer, is assisting the project as much as possible.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electric Radiators.

Referring to "Experiment's" article on radiators in the issue of March 2nd, I do not consider that he is wholly correct in his conclusions. Writing simply as an observer, like himself, I rather think he misses the chief point of the electrical radiator. This heater is used chiefly as a convenience heater. For regular heating (for obvious reasons) it has not a large field. In consequence, the public demand a radiator which will give a cheerful glowing effect immediately it is switched on.

An element of the type he suggests would take some time to build up. Further, there would appear to be no gain by placing a spiral in a horizontal position; a larger area is left for the cold air to play upon—hot air will rise, and there will be convected heat just the same. In the case of vertical spirals, the air passing the lower coils is heated, therefore hot air passes over the upper portion.

It is agreed that more radiant heat is required, but this probably means sacrificing the outstanding feature of the electrical radiator, *i.e.*, the production of a real red heat as soon as it is switched on.

There should be no considerations in the design of a radiator to prevent the bars from reaching a high temperature, as the radiant heat emitted increases proportionally with the increase in temperature.

It is doubtful whether primarily the failure of the lamp radiator can be attributed to too much convected heat. I should rather suggest it was lack of thermal storage. The filament of the lamp being *in vacuo*, practically 100 per cent. radiant heat is given off. Glass is not totally opaque to heat rays. It is granted it has a high capacity for sifting these rays, but it is to some extent diathermanous, and there is the probability that it is more so as the temperature is increased. Radiant heat also is emitted from the heated glass.

F. Cope.

Stanley, *March 19th*, 1917.

Curious Trouble with Lead-Sheathed Cables.

Being interested in the cause of the above trouble, and after observations extending over many years leading me to a somewhat different conclusion to the various causes set out by your other correspondents, I should be glad to hear if anybody has ever experienced a similar trouble to the one mentioned by Mr. G. W. Partridge, on either buried or manhole joint-boxes of the brass gland type, *i.e.*, one in which the lead sheath has been plumbed on to a brass gland which is then screwed up to the cast-iron or lead containing box surrounding the joints; for, although I do not consider this an ideal type of box, after many years' experience with boxes of this type, I cannot record one of this type having failed in the way in question.

The previous correspondents all appear to me to be of the opinion that the trouble is one peculiar to joints on cables "drawn-in," but this is not so, for I have had trouble on cables laid "direct" and laid "solid" in wooden troughs.

Whilst I do not suggest that it is from the same cause, it might interest some to know that I have had experience of two drums of cable (three-core E.H.T., paper insulated, L.S., S.W.A.) in which a very similar trouble extending completely around the cable, in both cases within a couple of yards of the running end, was apparent before the cable end was released for pulling in from the drum.

A. R. Chaytor.

Dewsbury, *March 13th*, 1917.

The "Bauer" Qualimeter.

Our attention has been drawn to a note, on March 2nd, to the effect that Messrs. F. R. Butt & Co. have applied for and obtained a licence to use the German patent No. 25,101 of 1912, the instrument being known as the "Bauer" Qualimeter.

In this notice it is stated that Messrs. Butt & Co. have had difficulty in getting these instruments from our firm, who had previously obtained a licence to manufacture them, and that they therefore concluded that we were not in a position to manufacture.

We beg to state that we are making these instruments in considerable numbers, and that Messrs. Butt & Co. have from first to last only placed one order with us, which order has long ago been fulfilled.

We do not know why the Controller of Patents did not ask for our evidence on this matter before taking further action, but as a statement such as that inserted in your paper is apt to do us harm as leading makers of X-ray apparatus, we should be very glad if you would insert this contradiction.

Newton & Wright, Ltd.

London, W., *March 16th*, 1917.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,208. "Dynamo." T. Cooper. March 5th.

3,235, 3,236. "Electric controllers, &c." J. Anderson & G. Ellison. March 5th.

3,250. "Use of relays for telegraphic, &c., purposes." H. W. Sullivan. March 5th.

3,253. "Electric heating elements." L. G. Caunter. March 5th.

3,258. "Miners', &c., electric safety lamps." O. Oldham. March 5th.

3,274. "Dynamo-electric machinery." Lancashire Dynamo & Motor Co. and G. E. Mason. March 6th.

3,285. "Electrochemical process for treatment of metallic ores." C. O. Griffith. March 6th.

3,290. "Electric controlling of locks of lockers, &c." A. A. Grant. March 6th.

3,295. "Systems of control for electric motors." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 6th

3,318 "Control and regulation of electric furnaces." Brown, Boveri and Co. & A. Gray. March 6th.

3,347. "Spark plug intensifiers." O. G. Singer. March 7th.

3,360. "Telegraphic relays." J. A. Fleming. March 7th.

3,368. "Electrical marine depth indicator." E. A. S. Swinson. March 7th.

3,394. "Regulating or controlling systems for electric motors." Electric and Ordnance Accessories Co. & J. Etchells. March 7th.

3,400. "Electric lighting systems for motor road vehicles." F. D. M. Gordon. March 7th.

3,401. "Electric lamp for miners, &c." F. D. M. Gordon. March 7th.

3,422. "Welding or sintering tungsten ingots, &c." M. J. Insull. March 8th.

3,423. "Compressed tungsten powder and production of same." M. J. Insull. March 8th.

3,425. "Electrical contacts." M. J. Insull. March 8th.

3,426. "Electric furnaces." M. J. Insull. March 8th.

3,437. "Systems of electric motor control." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 8th.

3,464. "Magneto-electric machines for ignition in internal-combustion engines." M. S. Conner. March 9th.

3,476. "Regulating voltage of alternating-current system." A. M. Taylor. March 9th.

3,485. "Electric welding or soldering." L. Tweedale & Quasi-Arc Co. March 9th.

3,486. "Electric welding or soldering of metals." Quasi-Arc Co. & W. L. Cole. March 9th.

3,494. "Electric furnaces." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 9th.

3,524. "Electric heating elements." L. G. Caunter. March 9th.

3,531. "Machine switching telephone system." F. R. McBerty, L. Polinkowsky & Western Electric Co. March 10th.

3,534. "Trolley pole head for tramcars, &c." J. Pratt. March 10th.

3,549. "Disconnecting boxes for electric cables." W. T. Henley's Telegraph Works Co. & E. Moor. March 10th.

3,551. "Apparatus for direct conversion of energy of motion of water or other dielectric into electric energy, and conversely for conversion of electric energy into the motion of mass." A. Young. March 10th.

3,558. "Apparatus for reception and utilisation of electric current impulses." Selective Signal Co. & W. J. Lyons. March 10th

PUBLISHED SPECIFICATIONS.

1915.

13,888. Dynamo-electric Machines. F. A. Heys (Neuland Patents, Ltd. September 30th.

14,500. Radio-telegraphy. J. Bethenod & E. Girardeau. October 13th (October 15th, 1914.)

17,615. Loading Coils for Superimposed Telephone Working and other purposes. C. E. Hay & H. W. Sullivan. December 16th.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

2,346. Electric Air Purifying or Conditioning Apparatus. A. F. Berry February 16th, 1916. (104,019.)

2,347. Oil-cooled Electric Transformers. A. F. Berry. February 16th 1916. (104,020.)

2,547. Dynamo-electric Machinery. Lancashire Dynamo & Motor Co. and H. B. Whitmore. February 21st, 1916. 104,027.)

3,336. Incandescent Electric Lamps. J. T. Corneille & E. R. Grote. March 6th, 1916. (104,039.)

3,797. Mount for Magneto Distributors. E. J. J. Salmson. March 14th, 1916. (104,046.)

4,186. Railway Signalling. J. P. O'Donnell & S. L. Glenn. March 21st, 1916. (104,052.)

5,343. Electric Lampholders. A. P. Rutherford. April 12th, 1916 (104,070.)

5,807. Distance-operated Mechanisms and Signals connected to Electric Supply Systems. H. E. Angold, W. Duddell, A. H. Dykes, H. W. Handcock and C. Oliver. April 20th. (104,077.)

5,986. Apparatus for Producing Colour Effects in Theatres, Music Halls, and the like. W. E. Grant. April 26th, 1916. (Addition to 2,254/16.) (104,081.)

6,003. Lighting Fittings. British Thomson-Houston Co. & R. F. Peckham. April 26th, 1916. (104,082.)

8,959. Electrical Bonding Junction Boxes for use with Metallic-sheathed Wires and the like. G. S. Boothroyd and Callender's Cable and Construction Co. June 26th, 1916. (104,106.)

9,079. Sparking Plugs for Internal-combustion Engines. D. McGregor. June 28th, 1916. (Cognate application, 11,099/16.) (104,107.)

9,609. Electric Incandescent Lamps, and Method of and Means for producing the same. Deutsche Gasgluhlicht Akt. Ges. (Auerges). September 27th, 1915. (101,622.)

14,068. Method and Apparatus Applicable in Repairing Electric Power Transmission Masts for Overhead Conductors. J. A. Huscbye. October 4th, 1916. (104,131.)

14,276. Contacts of Electric Circuit Interrupters. British Westinghouse Electric & Manufacturing Co. October 9th, 1915. (101,796.)